# THE

# MECHANICS' MAGAZINE,

# MUSEUM,

# Register, Journal,

AND

# GAZETTE,

JULY 2nd.—DECEMBER 31st, 1842.

VOL. XXXVII.

"In arts mechanical, the first device cometh shortest, and time addeth and perfecteth."

BACON.

LONDON:
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1842.

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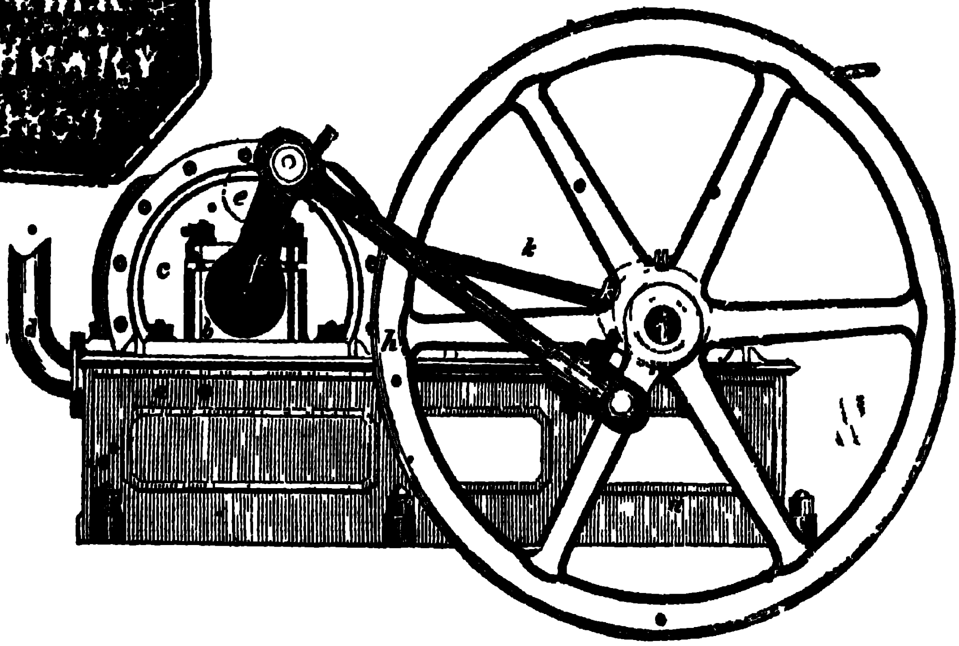
## THE CAMBRIAN STEAM ENGINE.

Fig. 1.



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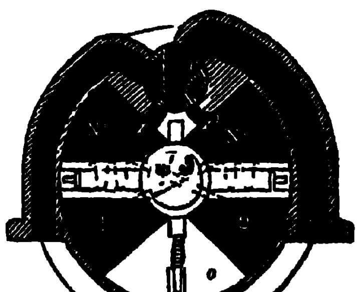

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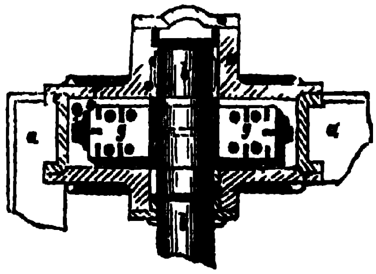

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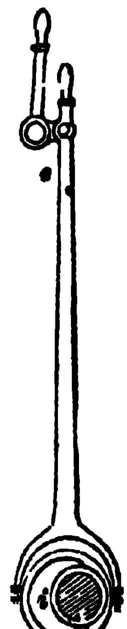

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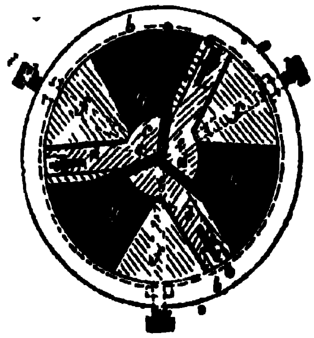
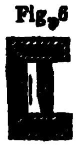


Fig. 5

Fig. 6



## THE CAMBRIAN STEAM ENGINE.

The steam engine to which the name of Cambrian has been given (in compliment, we presume, to the birth-place of the inventor,) is one of several inventions, included under a patent granted on the 7th of April, 1841, to Mr. John Jones of the firm of Messrs. Aspinall, Jones and Co. Engineers, Smethwick. It is of the class of engines, in which the pistons radiate from the axis of the steam cylinder, and move to and fro within certain definite portions of that cylinder; reciprocating in point of fact, but reciprocating within a circle, and having the external appearance of rotary engines; possessing, so far as regards diminution of weight and size, all the advantages of rotary engines, but without (as alleged) any of that inequality of wear to which all rotary engines, hitherto devised, are, more or less, subject. The points in which the Cambrian differs from others of its class, will be seen from the following description, which we extract from the Specification of the patentee, and nearly in his own words; but we may here state generally, that the master feature of the invention seems to consist in causing, by very simple and efficient means, the steam introduced into the cylinder, to act simultaneously on *both* of two radial pistons (on opposite sides, of course,) and in the greater equality and steadiness of action, which is the necessary result.

Fig. 1 is a front elevation of the principal parts of the engine. Fig. 2 a transverse sectional plan of the cylinder and piston, and fig. 3 a longitudinal section of the cylinder and piston. In fig. 1 *a* represents the framing; *b* plumber-block for bearings of the piston-shaft; *c* cylinder; *d* induction steam-pipe; *e* eduction steam-pipe; *f* crank on the end of the piston-shaft; *g* rod connecting the crank with *h* the fly-wheel; *i* driving-shaft; *j* plumber-block for bearing of the working shaft; *k* eccentric gearing for working the slide, or steam valve. A separate view of the eccentric gearing last named, is shown in fig. 1[a], in which *i* represents the driving-shaft, *k* the eccentric and connecting-rod, and *e* the case of the valve *v*. In fig. 2 and 3 the piston-shaft, with its two arms projecting therefrom, and two stuffing boxes, in which the shaft oscillates, are shown; $w^1$ $w^2$ are apertures or steam-ways formed in and through the shaft through which the steam passes alternately into and out of the cylinder *c*, as regulated by the steam abutments or blockings shown in fig. 3, and afterwards described. It will be seen from the figures that coiled springs are inserted in the arms which act upon two tongues intended to keep the metallic packing steam-tight. No. 1 and No. 2 are two chambers into which the cylinder is divided by the triangularly-shaped abutments or blockings *o o*; *v* valve in the case of the cylinder with passages $z^1$ $z^2$ in the adjoining blocking for the admission of the steam from the induction pipe (*d*) and its escape through the eduction pipe (*e*). Figs. 5 and 6 are separate views of the valve *v*; fig. 5 being a vertical section, and fig. 6 a top plan.

The action of the engine is as follows: Supposing the valve *v*, at starting, to be in such a position, that both the passages $z^1$ and $z^2$ are open, the steam flows through from the induction pipe, into the upper part of the chamber No. 1, and through the piston shaft by the steam way $w^1$, into the lower part of the chamber No. 2, and thereby acts simultaneously on both arms of the piston, but on opposite sides of these arms. As the arms of the piston are carried round by the force of the steam, any steam or air left in the lower portion of the chamber No. 1, and upper portion of No. 2 is expelled through the piston steam way $w^2$, the blocking passage $z^2$ and valve *v* into the eduction pipe *e*. And when the arms have completed one oscillation, the position of the valve *v*, is at that instant, by the action of the eccentric gearing *k*, so changed as to cut off the communication between the induction pipe *d* and the passage $z^1$, but to open that passage to the eduction pipe *e*, while on the other hand, and by the same change of position, the passage $z^2$ is shut off from the eduction pipe, but opened to the induction pipe, whereupon, the steam flowing in upon the sides of the arms opposite to

those first acted upon through the passages $z^2$ and $w^2$ produces the return stroke of the piston. And so the arms continue to oscillate as long as the supply of steam is kept up.

Instead of constructing the engine with two radial pistons, it may be made with three or with four. The patentee describes fully the variations necessary to be made in both cases; but it may suffice to quote his explanation of the three-piston variety.

In fig. 4, is shown the mode of constructing an oscillating engine with a three-armed piston, the said figure being a longitudinal section of the cylinder and piston, and their appendages: *a* is the piston shaft; *b b* the cylinder; *g g g* three steam chambers, in the cylinder, formed by the triangular blockings as previously described; *e e e* the steam ways in and through the steam shaft; *f f f* screws, coiled springs, and tongues similar to those before described, and intended to serve the like purposes.

The engine, whether constructed with two, three, or four radial arms, is one of great simplicity; and we make no doubt, also of equal efficiency and durability. The parts are few, strong, and well adjusted; the friction equally distributed and in amount inconsiderable. The liability to wear is small; to derangement still less. The engine is described in the specification as a high-pressure one; but it is so, we apprehend, in the sense only that it is worked by the pressure instead of by the condensation of steam; for evidently it may be worked at almost any pressure, from the 4 or 5lbs. at which low-pressure marine engines are ordinarily worked, up to the 50 or 60lbs. common with railway locomotives, and by the addition of an air-pump and condenser may be worked as a low pressure condensing engine.

What the expenditure of fuel required to work an engine of this description is, remains still to be ascertained. Several have been already built, and there is one of 16-horses power on the premises of an eminent London builder, which we have seen at work, and working admirably, the consumption of which is stated to be less than 6lbs. per horse power per hour.* A careful trial ought, however, to be made to determine the actual amount of duty which the Cambrian engine is capable of performing in a given time, with the consumption of given quantities of water and fuel; for until such trial is made, it is impossible to institute any correct comparison between it and other engines, in respect of working cost. From the manner, however, in which the steam, as admitted into the cylinder, is at once turned to useful account, and the small portion of its force that is wasted in overcoming the friction of the machine, we are strongly inclined to think that it will turn out to be one of the most economical yet produced.

We are here supposing that the engine is to be constructed and worked in one or other of the ways before described, and these only; but Mr. Jones has favoured us with another very beautiful modification of it, in which the steam is worked *expansively*, and by the adoption of which the consumption of fuel must be still farther materially reduced. Of this we shall give a full description at some future opportunity.

The applicability of the Cambrian Engine to marine purposes is particularly deserving of notice; since not only may the steam power be applied directly to the shaft of the paddle-wheels or other propellers, but the rate of speed may be regulated at pleasure by varying the diameter of the cylinder and number of the radial arms.

For locomotive purposes it offers also the great advantage of a direct transmission of the steam power from the piston

* Particulars of these engines and their performances may be obtained from Mr. H. Crosley, C. E., one of the proprietors of the Patent,—Cambrian Office, 59, King William-street, City.

shaft to the crank or axle of the driving wheel, by means of a single rod without couplings, and with a much less angle of connexion than is common with the engines now in use.

## PURIFICATION OF THE WATER SUPPLY OF THE METROPOLIS.

Sir,—It is my wish to call the attention of the public to a subject in which every one is materially concerned—I mean the purity of the water to the metropolis. I was much pleased with a letter which I saw in the *Mechanics' Magazine* some days ago, in which the writer (Mr. Canham) adverts to this very subject, and asks, *if it be true*, that a mode of filtration has been discovered which would purify all the water used in London, *why* has it not been resorted to? This *why*, has called forth a *wherefore*, in the shape of an answer from Mr. Stuckey himself, the inventor of the engine alluded to in Mr. Canham's letter. Mr. Stuckey declares that he is "ready to execute his plan whenever the public may desire to reap the benefit of it;" he says also, that "if this project has not been executed ere this, it arises from the backwardness of the companies to adopt his invention." Now, we know that some of them have expended much money in endeavouring to filter the water they distribute; but there are others, who, alarmed by the enormous expenditure which would ensue if they adopted filtration, have gone on without filtering at all, having much regard for their own purse, but very little for the health of the thousands of people who every day drink the liquid they thus receive without its first being purified. Some years ago, one company declared before a committee appointed by government, that it would cost them 3000*l*. a year to filter their water; another, that it would cost them 19,000*l*. per annum; and the Chelsea Company have been obliged to levy 15 per cent. upon the public since they adopted filtration. Now, if all that is asserted by Mr. Stuckey could be brought to bear, it appears to me, that in a matter of such paramount importance, the opinions, or views, of a few interested companies ought not to outweigh the public benefit, especially as the inventor proposes to filter the water *effectually*, at the very low average price of *sixpence per quarter* one house with another. Monopolies are the bane of every thing that should be generally advantageous; and in cases where the article consumed is one of such importance for our populous metropolis, as water, ought not to be allowed. I have the honour of being acquainted with the inventor, and feel a perfect conviction that what he affirms, he can do; and also I am convinced that the public will see, that if a machine of 5 feet square can perform so much, the benefit of his invention to the community at large can hardly be overrated. I have no doubt, that the public, like myself, would wish to see a plan so extraordinary and unique immediately adopted.

I have addressed this letter to you in the hope that you will allow it to appear in your excellent publication.

And am, Sir,
Your very obedient servant,
ALFRED SMITH

June 28, 1842.

## PATENT LAW CASE.

*Vice Chancellor's Court.*

June 21.

*Unsworth* v. *Bridget.*

This was a motion on behalf of the plaintiff, who was the patentee at Derby of "an improved tag for laces," for an injunction to restrain an alleged infringement of his invention by the defendant. The plaintiff claimed as his invention, "a tag having a tooth or burr, nib, catch, tongue, or other projection attached to or formed on the inside of the tag, either before or after the lace was inserted, to prevent the lace from being withdrawn from the tag at any time by ordinary use, and to enable the user of the lace to put on a new tag at any time." The tags manufactured and sold by the defendants were alleged to be in every respect the same as those of the plaintiff's, and an infringement in principle of the invention protected by the patent. The defendants alleged their entire ignorance that any patent had ever been granted to the plaintiff for what was termed an invention, but which was nothing more than an old mode of fastening the lace in the tag by means of two dents or notches, upon a principle which had long been applied to the ferules of umbrellas and walking-sticks, and moreover, that the defendants had made use of their contrivance for a long time before the date of the plaintiff's patent, having taken it from a tag which

was given to one of them by a lady's-maid, who said it was brought from Paris.

*Mr. Girdlestone* and *Mr. Metcalf* moved for the injunction; and *Mr. Richards* and *Mr. Wood* opposed.

*His Honour* said, he felt some difficulty about granting the injunction, because he could not but think there was a substantial difference between the thing that was claimed by the plaintiff's specification, and what the defendants had been making. It was not for him now to pronounce an opinion whether the patent was good or not, but he thought there was a sufficient difference between the articles manufactured by plaintiff and defendants to justify the Court in refusing the injunction, and directing the plaintiff to bring such action as he should be advised, to establish the validity of his patent, with liberty to either party to apply to the Court. [We pointed out the untenable character of this patent at the time it was specified. See *Mech. Mag.* vol. xxxiii. p. 445. Ed. M. M.]

## IRON SHIPS.

The most venerable, the most deep-rooted, and by far the most respectable of all our national prejudices, is that which every person of English birth entertains in favour of the "Wooden Walls of Old England." Identified as they are with our noblest triumphs as a people—with centuries of inviolability at home and of conquest abroad—it is not to be wondered at that we should love them dearly. The "good old times" have handed down to us nothing that we venerate more, if indeed so much. Even our rights and liberties—yea, the very monarchy itself—may be said to have always held but a secondary place in our regard. We have put up with tyrants and done without kings, but never has the idea once entered into the national mind of dispensing with our "wooden walls." Of no common wood, too, are these same walls—"hearts of oak" every one, and of sound old English oak the best of them. Loved they are, not only for what they have done for us and for our forefathers, but for their own sakes, as (mostly) natives of the same sea-girt soil, and partakers of the same illustrious fortunes. England's glory and safety, and England's wooden walls are so intimately mixed up together in our memories and affections, that to separate in our thoughts the one from the other is found next to impossible.

The day is at last come, however, when John Bull must be reasoned out of this ancient prejudice—when he must be taught to place his trust in walls of other stuff than wood—when, if he would have his "meteor flag" brave for another "thousand years" the "battle and the breeze," he must build his floating towers of a more impregnable material, than any which his native forests have ever produced.

It may perhaps serve to procure from the old gentleman a more patient hearing for the subject matter of our present discourse, if we state at once that there is nothing outlandish—nothing *French*, especially—in the material proposed for his adoption, and that it has as good a claim by right of birth to his favour, as his ancient oaks themselves. All that is required of him is to build his ships of iron instead of wood—of iron, the produce of our own mines, and the industry of our own people—made from native ores, with the aid of another of our native products, coal—and both the iron and the coal being things which we possess in greater abundance and can produce cheaper than any other nation on the face of the earth.

The use of iron for ships is commonly supposed to be of very recent origin, but Mr. Grantham, the author of a work on the subject* which has been just published, and is by far the best on it which has yet appeared, shows that its value as a material for ship-building has been known for a great many years, during which it has been making sure though slow progress towards its now fast-extending popularity. Forty years ago boats of iron were known upon canals; and some of this description were lately cut up, which had been twenty-eight years in use. The first iron vessel that ever put to sea was the steamer *Aaron Manby*, built by the Horsley Iron Company, for the Seine, and named after its spirited projector. She was completed in 1821, sent to London in parts, put together in one of the docks, and navigated by no less a person than Captain (now Sir Charles) Napier, from London to Havre, and thence to Paris, being, says Mr. Grantham, "the first and only vessel of any description that ever went direct from London to Paris."(?) Mr. Manby built subsequently three other iron steam-vessels for the Seine—one at

* "Iron as a Material for Ship-building, being a Communication to the Polytechnic Society of Liverpool—By John Grantham, C. E., President," 96 pp., 8vo, with numerous plates. Simpkin and Co., and Weale, London.

the Horsley Iron Works, and the two others at his own works at Charenton, in France. The whole of these vessels are understood to be still at work on the Seine. Mr. Manby states, as of his own knowledge, that "from 1800 to 1822, the hull of the *Aaron Manby* never required any repairs, although she had been repeatedly aground with her cargo on board." The next iron steam-vessel mentioned in Mr. Grantham's retrospect, was built, under his father's superintendance, by the Horsley Company for the Shannon navigation in 1824-5; "Since then she has been constantly at work, and is now in good condition."

"This vessel was the origin of the extensive and spirited company which now occupies that splendid river, and which is conferring important benefits on the large tract of country through which the Shannon flows. My friend Mr. Williams, managing director of this and the City of Dublin Steam Packet Company, at this time directed his attention to the subject of iron vessels. With his usual discernment he foresaw the advantages to be derived from this source to steam navigation, and has ever since been a steady advocate of the principle. It was at his recommendation that the Shannon Company continued to construct iron steam-vessels, and there are now six at work, all in excellent condition, two of them in salt water."—p. 8.

Mr. Grantham's notices of the subsequent progress of iron ship building do not follow in very regular order, and are, on the whole, extremely incomplete, but, such as they are, we give them as they present themselves.

Iron vessels now began to attract the attention of those who were engaged in river and canal navigation, and several were built in this country and on the Continent. "The first that were built in Liverpool were undertaken by Messrs. Fawcett and Co., and under the superintendance of Mr. Page." "Shortly after this time Mr. John Laird, of North Birkenhead, commenced building them on a large scale, and has since been extensively and successfully engaged in this pursuit. Mr. Fairbairn, of Manchester, also very early took an interest in iron vessels, and was a party to a series of experiments made at Glasgow, in which iron vessels were employed." "Many others have now commenced the business, and numerous iron steamers, and iron sailing vessels of large tonnage are now afloat or building. Great numbers of iron steamers are now plying on the Thames (where the principal builders are Messrs. W. Fairbairn and Co., and Messrs. Ditchburn and Mare,) the Mersey and the Clyde, and on nearly all the continental rivers. Some of a larger and stronger description are regularly employed in making sea voyages with heavy cargoes." "The iron steamers running between Liverpool and Glasgow, and built by Messrs. Tod and Macgregor are well known. Of these the *Princess Royal* is the largest, being upwards of 800 tons. She is a fine vessel of immense power, and is unequalled in speed as a sea-going steamer." "Iron vessels also are now fighting our battles in the East, among which, the *Nemesis* and *Phlegethon*, built by Mr. Laird, are entitled to particular notice from the prominent part these vessels have taken in the Chinese war." "Of iron-sailing vessels, some have made voyages, both to the East and West Indies." "The *Ironside* was the first iron-sailing vessel of any magnitude that was employed for sea voyages, and she has been highly successful." The *Great Britain*, now building at Bristol, and better known as the *Mammoth*—the completion of which the scientific world is truly stated to be awaiting with intense interest,—is to be all of iron. To these historical particulars we must not forget to add, that Mr. Grantham himself engaged about three years ago very extensively in the building of iron vessels in partnership with some other gentlemen, (under the firm of Messrs. John Grantham and Co., of Liverpool,) and is therefore well qualified by special acquaintance with the subject, as well as by general scientific attainments, to write upon it with advantage to the public.

The advantages which iron vessels possess over those of wood, are treated of by Mr. Grantham, under the heads of—

Strength and Lightness.
Capacity for Stowage.
Safety.
Speed.
Durability.
Economy in Repairs.
Cost.
Draught of Water.

And in every one of these respects, he proves clearly and satisfactorily, that iron vessels have decidedly the advantage. We select for exemplification, one or two striking passages.

## POSSIBLE MAGNITUDE OF IRON VESSELS.

"The great strength of malleable iron to resist strains in every direction is well known; but, to those who are not conversant with the subject, the extent to which this advantage may be carried is not at first apparent; or how the material may, from comparatively small pieces, be so combined in large masses, as to form the ponderous body of a ship; and they are thus too apt to prescribe a limit to its use. An opinion, indeed, is now very generally entertained that iron may be suitable for small craft, but is inadequate for the construction of vessels of heavy burthen. This, however, is a supposition so erroneous that the reverse would be much more correct; for large vessels will afford the best practical demonstration of the superiority of iron for ship-building. In the application of timber, obstructions increase in a ratio proportioned to the increased size of the vessel to be built. How often has the ship-builder the greatest difficulty in obtaining timber to suit the varied curves of our finest ships! How often is the country despoiled of its noblest ornaments by the tempting prices he is compelled to offer for its most magnificent oaks, the largest of which are frequently insufficient for his purpose! How are his brains racked, and his patience tried, in seeking for crooked timber necessary to frame a sharp floor, or a square bilge! How often is he obliged, though he knows it to be injurious, to scarf the frames, for which no timber can be found sufficiently large to enable him to avoid such defects! And is not this one cause, amongst others, why our building yards are empty while our ports are filled with ships from other nations, in which timber is more plentiful and the choice more extensive!

"But how stands the case when we turn to iron? Where is the frame, even of the most intricate form, that our smiths cannot mould? Where the frame or beam so large that iron cannot be found of which to fashion it, and that, too, if need be, without a scarf? Here there are no knots, no sap, no cutting across the grain. Here there is no useless timber, placed merely to *fill in*, or to cross buts. Here every inch of material is of service, and every scrap applied to some useful end."

* * * * * *

"If we view the subject with respect to very large vessels—ships of the line or first-class steamers, in which intermediate decks are not only not objectionable, but requisite for the guns and stores, and in which entire or partial bulkheads may be multiplied without causing much inconvenience—we have in iron the means of dividing the shell into small sections, affording the strongest supports directly opposed to the strains that tend to disturb the form of the plates, and in the direction in which they can least resist such strains. The sides between these decks and bulkheads would be strengthened by the ordinary mode of framing. In addition to this, the lower part of the vessel might be again intersected by longitudinal divisions; and these decks, bulkheads, and subdivisions would not only be securely fastened to the shell, but to each other,—the whole thus becoming a mass of almost irresistible strength, meeting the strains in whatever direction they might arise, while, at the same time the weight would be far below that of a timber vessel of only moderate scantling, and the room for stowage would be much greater."

## DURABILITY.

"Where, I would ask, in the catalogue of objections, real or fancied, to iron ships, is there one to be found equal to that dreadful scourge to wooden vessels—the *dry rot*: the effects of which are too well understood by shipowners to require any lengthened remarks from me? No age has been without its nostrums, its quackeries, and its 'infallible remedies' for the *dry rot*, and no period has been so productive of them as that in which we live; but, from all I can perceive, this plague is as prevalent as ever. A circumstance which has recently fallen within my observation is strongly illustrative of this subject, as involving the comparative merits of wood and iron. On removing the timber-work of the *John Garrow*, preparatory to the alterations determined upon in that ship, we find that the dry rot had already (though she was not three years old) begun its work of destruction. That part of the lower deck which had been laid some time after she was launched had become decayed, and all the timber not exposed to the air was more or less affected. The iron, on the contrary, though it had been exposed to a fourteen-months' voyage, without being either cleaned or painted, was in a most satisfactory state. Not only were the plates and frames free from any perceptible injury, but the edges of a number of square bolt-heads, in and about the rudder, still retained their sharpness, and appeared to be perfectly free from corrosion. The dry rot in wooden ships (which finds no parallel evil in those of iron) is frequently as remarkable in the earliness of its commencement as it is invariably rapid in its progress, and no appliance hitherto resorted to has, in all instances, been effectual to avert its insidious development, or to arrest its destructive progress. How many stately vessels are now mouldering away under this destructive visitation, while

their fine and graceful forms conceal the treacherous enemy within!"

ECONOMY IN REPAIRS.

"The wear and tear of iron vessels (and I speak confidently from actual experience) are practically trifling, and the repairs are consequently light. This item, which in wooden vessels presses so heavily on the profits, is, in iron vessels, of but slight importance; and although the comparison will be found very favourable in iron sailing ships, the fact will be more clearly shown by reference to steamers. The usual calculation for a timber-built steamer is, that the expense of repairs will, in ten or twelve years, have equalled the first cost. In a well-built iron steamer repairs will not, I believe, have become necessary within that period, provided the vessel has not been injured by accidents; and, under any circumstances, I feel confident that it will be more expensive to keep in repair the copper sheathing alone of a wooden vessel, than to effect the whole repairs in the hull of an iron vessel.

"I revert to canal boats as furnishing a fair demonstration of the comparative merits of wood and iron. My informant in this point states that iron vessels are kept in repair at very little expense, but that wooden boats, when four or five years old, begin to be very expensive; as much so, indeed, in one year, as iron boats will in three or four, or even more. He mentions boats which he knows to be ten or fifteen years old respectively, and which are still in excellent condition. 'I know of some,' he says, 'that have been at work upwards of eleven years, and have not cost more than 2*l.* each during all that period.' Messrs. Tod and M'Gregor, of Glasgow, in writing on this subject, say,—'Some of the vessels we built were not in dock, or on a slip for four years: their bottoms were never seen, yet when examined they were found to be as entire as on the day they were launched. The hulls of some of our iron river steamers have not cost 1*l.* each these five years. Knowing their stability, we are very anxious to get sea-going vessels of iron introduced. The *Royal Sovereign* was, we believe, the first regular sea-going iron vessel in this country. The first six months she ran 25,000 miles under great disadvantages, she having to encounter dark nights and low water in coming up the Clyde; yet during this time lost not one trip, but was punctual to the time advertised.'

"In the event of accidents, the repairs of iron ships are extremely light, and in this respect also they bear a most favourable comparison with wooden vessels. The cases that have fallen within my own observation are so numerous, and so decisive of this fact, that, were it not superfluous, many pages might be filled in recording them.

"The *Nemesis*, war-steamer, ran on one of the Scilly rocks in the British Channel with such violence that, to use the expression of my friend Mr. Claxton, the harbour master of Bristol, 'if she had been of wood she would most probably have left her bones there.' The damage she sustained by the shock was, however, so trifling, that she was navigated round to Plymouth, where the repairs were easily effected for about 30*l.*"

Nor is it solely on the ground of the intrinsic superiority of iron over wood, that the case in favour of iron vessels rests. The universal adoption of the new material is recommended by other considerations, which, if iron were only as good as wood, ought to command, for them, the preference. Mr. Grantham calculates that it requires the constant occupation of about 400,000 acres of land, on which to grow the timber for the ships annually built in this country and in our colonies; and he proceeds to show, how by the adoption of iron, not only would all that vast quantity of land be set free for the production of human food, but a new and most extensive source of profitable employment for our people be opened up.

"So much of the timber thus employed as is grown in this country occupies a proportionate amount of land that would otherwise be appropriated to agricultural purposes; so much of it as is not grown here, takes our capital, to a certain extent, out of the country; but, worse than all, our people are deprived of profitable and extensive employment by the inducement to build ships in those countries where the material is most abundant. By the evidence of Mr. Meek, who was lately commissioned by government to enquire into the state of trade on the continent, in relation to this country, we learn that it is impossible for our ships to compete in freight with those built by several other nations, owing principally to the comparatively low rate at which they can procure the materials for building. Notwithstanding the great sacrifice now being made in the revenue of this country, by the reduction of duty on foreign timber, and the consequent decrease that will probably be made in the price, the foreigner will still have an advantage over us in having the material not only considerably cheaper, but at his own door, while our supply will necessarily be precarious.

* * * * * *

"But let iron become the material with

which our ships are henceforth to be built, and the whole question assumes a widely different and highly cheering aspect. Without being in any degree dependant on foreign countries, we should find an inexhaustible supply of more suitable and less perishable material for the whole of our national and mercantile marine in our own country; from this source our iron-masters would have a fresh and a steady demand for their iron; and an increased demand for labour, both at the mines and in our building yards, would be the immediate and invaluable result."

Mr. Grantham investigates also the principal causes which obstruct the progress of iron ship-building, and finds the national prejudice, of which we have before spoken, and some other prejudices of a more vulgar cast, to be at the bottom of most of them. The supposed difficulty of steering iron vessels by the compass, he considers to be a fair ground of objection; but this also is most satisfactorily disposed of.

HOW TO REGULATE THE COMPASSES OF IRON SHIPS.

"When the *Ironside* was ready for sea, Professor Airy came to Liverpool and made a series of observations upon her, with a view to the correction of the local attraction of the ship. This object he effected in the most satisfactory manner; and not the less so that the plan he adopted was exceedingly simple. Mr. Airy afterwards, with great liberality, published in the *United Service Journal* a list of rules, by observing which, any one might correct the compasses of iron vessels, without difficulty.* This system is found to be so efficient, that when applied to iron vessels the compasses are generally more correct than those in vessels built of timber. Few ships are free from some local disturbing influence; but it is not considered to be so great in wooden ships as to require correction, and the commander having discovered its extent, makes allowances for it in his calculations. The compasses in iron ships are, however, so accurate, after being corrected, as to be free from any sensible error.

"The power of the magnets, and the intensity of the magnetism of the ship, will probably alter by time; but I have not heard that this effect has yet been observed on any compasses that were well corrected. A careful navigator would, however, soon observe any deviation that might arise in them, and on his return to port have them again corrected; as iron vessels become more general, some one will be found in each port capable of performing this operation with sufficient exactness for all practical purposes."

The Construction of Iron Vessels is treated of in great detail under the different heads of—Keels—Stem and Stern Posts—Floorings—Side Frames—Gunnels—Plating—Jointing—Single and Double Rivetting—Deck Beams and Bulkheads—and on all these matters, much valuable practical information is communicated.

The following statement of the proportions observed in the building of the *Great Britain* (late *Mammoth*) and other particulars respecting her, furnished to the author by Mr. Guppy, the Managing Director of the Company to which she belongs, will be read with interest.

*The Great Britain.*

"Her dimensions are truly gigantic; they are as follows:—

| | feet. |
|---|---|
| Length of keel | 289 |
| Length from figure head to tafrail | 320 |
| Beam | 51 |
| Total depth from underside of the upper deck to the keel | 31 4 in. |
| Draft of water when loaded | 16 |
| Tonnage, per old measurement, about | 3500 tons. |
| Displacement of water when drawing 16 feet, about | 3000 " |

"The plates of the keel are from ⅝ths of an inch thick in the middle, to 1 inch at the ends; and all the plates under water are

* The operation may be shortly described as follows:—Having fully completed the equipments of the ship, especially as regards the iron-work, and having determined the exact position in which the compass is to be placed—take a point on the deck, exactly under it—through this point describe two lines on the deck, one parallel to the keel and the other at right angles with it. Provide two powerful magnets, about 2 feet long, and a small box, 7 inches long by 3 wide, full of small iron chain, or small pieces of iron, laid in different directions. The vessel, being in a wet dock, should be firmly moored by four hawsers, and her head being made to point exactly to the magnetic north, as ascertained by a delicate azimuth compass on shore, an observation should be made. The needle will now probably be found to be very incorrect: one of the magnets should then be slipped along the athwart ship line, either over or under the deck, till the needle points correctly. The ship's head may then be turned due east, and the other magnet, being placed on the fore and aft line, is so regulated that the error, if any, in the needle, is corrected in this position also. The vessel should then be moved round to all the four points, north, south, east, and west, and any error now observed may be corrected by again changing the position of the magnets. It is now necessary to point the head of the ship towards the north-west, or south-east, and any deviation that is observed will be corrected by the use of the small box of chain, the exact spot for which must be determined by trial. These corrections carefully attended to will cause the compass to be free from all sensible error. The magnets should be of the best description, and be placed in a box full of tallow, which box may be nailed to the deck or the ceiling of the cabin.

from 5/8ths to 1/2 inch, at the top, except the upper plate, which is 5/8ths. She is clencher-built, and double-rivetted throughout. Towards the extremities, and quite aloft, the thicknesses are reduced gradually to 7-16ths.

"The ribs are framed of angle-iron, 6 inches by 3 1/2, by 1/2-inch thick at the bottom of the vessel, and 7-16ths thick at the top. The mean distance of the ribs from centre to centre is 14 inches; and all these ribs will be doubled: the distance is then increased to 18 inches, and then gradually to 21 inches at the extremities.

"The boiler platform is of plate iron, supported upon ten iron kelsons, of which the centre ones are 3 feet 3 inches deep. These kelsons are formed, like the floorings, of iron plates placed on edge. The hull is divided into five distinct compartments by means of substantial water-tight iron bulkheads.

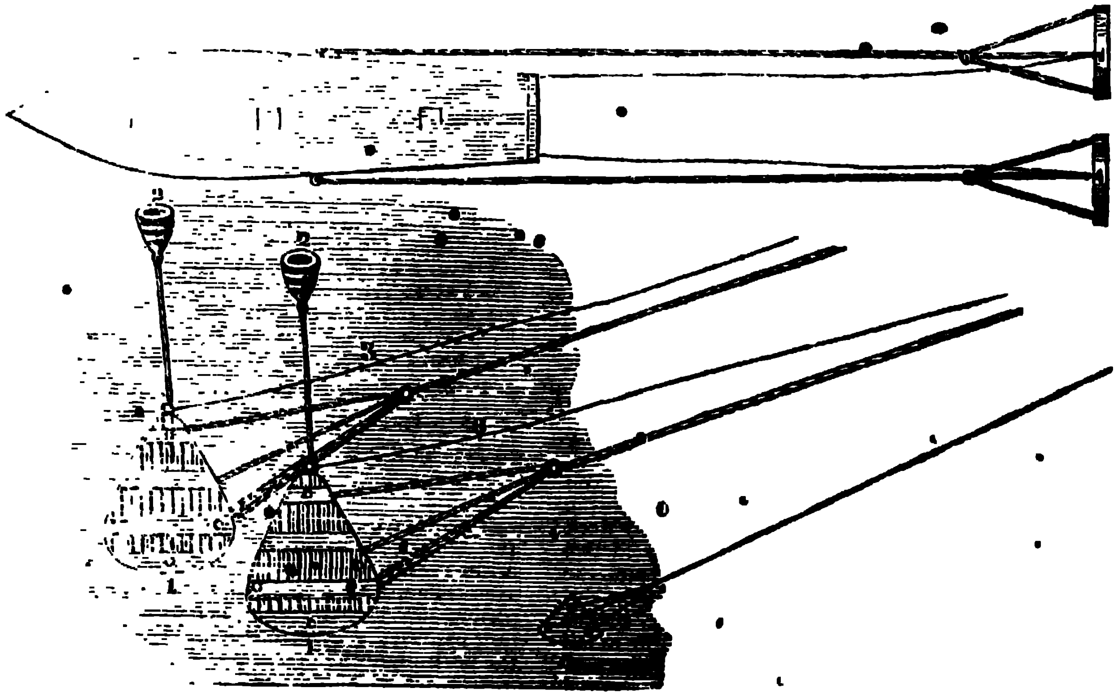
"The decks which are of wood, consist of the cargo deck, two cabin decks, and the upper deck.

"It would be an endless task, and, without the aid of drawings, a fruitless one, to attempt a description in detail of the construction of this magnificent vessel. I can, however, state that her lines are very beautiful, and adapted to attain the highest rate of speed. The general character of the workmanship is very good, and does great credit to the builder. Her exquisite proportions prevent that appearance of heaviness which is generally observable in large ships; and, although she is probably the strongest vessel ever built, she has a remarkable air of grace and lightness."

How this prodigious floating mass is to be propelled—that is, how the power of the engines is to be made available to the propulsion of the vessel—is not stated. We gather only from the breadth assigned for "the beam," and the absence of all mention of paddle-boxes, that it is *not* to be by paddle-wheels.

We take our leave of Mr. Grantham with our hearty thanks for the service which he has rendered by his publication, not only to the whole ship-building craft, but to the nation at large. He is the first who has set the subject of it fully and fairly before the public; and we venture to predict will do more by his little work; to promote the universal adoption of iron in the building of ships, than will be effected even by the launching of the Bristol Leviathan.

## JONES'S WATER KITES FOR THE PREVENTION OF SHIPWRECK ON A LEE SHORE.



[Description by the Inventor.]

The inventor begs respectfully to call the attention of all parties connected with shipping, and the world generally, to the present important discovery. The inventor, who has made it his particular study for upwards of twenty years, to discover by some means or other a plan to prevent ships being driven on a lee

shore, feels great pleasure, after a variety of trials and failures, in laying his plans before the public for their inspection; at the same time, the inventor begs to state, that he does not intend to secure to himself the benefit of his discovery by patent right, but is anxious to throw open his invention to all parties who may choose to adopt it, without any remuneration whatever. The prefixed sketches will at once give the public an opportunity of judging of the correctness of his plans. Those who have taken notice of a fish in a strong current, must have observed that a fish checks its speed by the expansion *of its fins* against the *fluid*. It is also well known by every person connected with shipping, that a small piece of wood of an angular form is used on board of a ship, for the purpose of giving the rate at which the ship is sailing, (see fig. 4;) this is called the ship's log. This angular piece of wood, and line attached, is thrown into the sea; the bottom part of the wood being made much heavier than the top causes the wood to sink perpendicularly in the water with a rope fastened at each corner, which causes the flat part of the log to face the ship; by this means the log, having a body of fluid against it, remains stationary when the ship is going at the rate of ten knots an hour. It is also well known, that unless the small wooden peg which is placed in the top corner of the log comes out by a sudden jerk of the line, this small piece of wood will require two or three men to pull it towards the ship. The figures 1 2 are upon the same principle of the log, only upon an *enlarged scale*, or I might say upon the principle of a boy's kite in the water reversed; instead of pulling against air, it is pulling against an *immense weight of fluid;* there is this difference, the boy's kite is made of paper, and the water kite is made of *strong timber*, with *strong ropes* attached to the sides of the vessel. The water kites should be made heavy at the bottom and light at the top, so as to keep perpendicular in the water; fig. 2 is supposed to be the tail of the kite, 10 feet long, with a buoy made of cork, so as to swim upon the surface of the water, and to cause the water kites to rise and fall with the motion of the waves. A small rope (fig. 3) is employed to *haul* the water kites towards the ship *horizontally:* the ropes from the sides of the ship to the water kite should be from 100 to 150 yards long, so as to give as much play as possible; the size and strength of the water kites, also the ropes, must be regulated according to the size of the vessel. The opinion of the inventor is, that the speed of a steam-ship of 400-horse-power, with her engines at full work, would be immediately stopped upon the same principle; in fact it is impossible to calculate the immense weight of fluid the ship would have to pull against.

There is another important advantage to be derived from the use of these water kites when vessels are off the land in foggy or hazy weather; by using them the ship would remain stationary, although in deep water, till the weather became clear. A case in point: the *Forfarshire* steam vessel, trading between Hull and Dundee, ran on the rocks off the Fern Islands, and became a complete wreck, during a very foggy night: this accident, and many others, might have been prevented, had the vessel been provided with the water kites, and *use been made of them when the fog first came on.* How much safer would it be for captains of ships, in foggy weather, when off the land, to lose a few hours rather than run the risk of so many lives, as well as property!

J. JONES.

Sheffield, May 20, 1842.

THE SMOKE NUISANCE—ADDRESS AT THE MANCHESTER VICTORIA GALLERY—BY C. W. WILLIAMS, ESQ.

(Continued from vol. xxxvi, page 494.)

Of the modes of estimating the quantity of heat generated, and which is among the most difficult objects in the course of practical experiments, I will explain some of those by which I have obtained my results:—These are, 1st. The use of copper bars, one end of which is inserted in the flues; the other projecting outside, on which a thermometer is fixed. The use of these is shown by an engraving in the *Mechanics' Magazine*, No. 971.

These bars necessarily give but relative temperatures; as the heat, influencing the thermometers, has to be transmitted through the bars. At the foot of the chimney it was found that when the bar thermometer indicated 300°, the heat within the flue was at least 750°. This fact was ascertained by means of fusible metals placed within the flue. 2nd. The use of this series of fusible

this effect, but the making of the boilers of such a shape, that the *air* which passes through the fire should be ***robbed of almost all its heat before it can escape.***" I ask, then, why not ascertain how much of the heat is thus taken up, and how much of it escapes? For the question of economy hangs as much on the quantity that escapes, as on that which is employed,—influenced, first, by the limited absorbing power of the boiler-plate surface; second, by the greater quantity of escaping products from the increased draught; and, third, by the increased temperature of such products. Thus, the quantity of fuel used will bear a relation to all these terms, and not to the quantity of steam generated. Nature requires increased *surface* or increased *time*. Two superficial feet of absorbing surface, acting for one hour, may be taken as equal to one foot of surface for two hours,—the temperature in the flues being the same. A more perfect combustion can only be profitably brought into action and rendered available by two means, namely, by extending such surfaces, or by increasing its heat-absorbing and transmitting quality.

I would, then, caution experimentalists, that, in calculating the general economy of any system of combustion in the furnace by the weight of water evaporated, without taking into account the quantity lost by the chimney, and considering that quantity as equivalent to an increased evaporative power, such a mode of calculation would be deceptive in every sense. For, suppose 1,000 units of heat to be generated per second of time from one pound of coal, the weight of water evaporated will depend on the number of those units absorbed by the water. If 800 be absorbed, 200 will be lost; if 500 only be absorbed, 500 will be lost; yet 1,000 units are generated in both cases. By which, then, shall we test the evaporative power of the boiler or of the fuel? It is clear that some other test must be supplied than the quantity of water evaporated; yet on this item alone do engineers dwell.

For my own part, and on that of the sounder portion of the inventors, I assert that, in undertaking to effect a more perfect combustion of the gases in a furnace, as we do in the Argand lamp, I *do* undertake that the result will be a great addition of heat; but I *do not* undertake that the boiler shall give a commensurate increase of *steam*. To cure the disease of the furnace, does not imply the curing the disease of the boiler. If a physician be called in to cure one disease, his success is surely not to be estimated by the progress of a different one. It would be just as legitimate to determine the efficacy of a *boiler* by the work done by the *engine*, as to decide on the merits of a *furnace* by calculating the work done by the *boiler*. The furnace is connected with the boiler, as the boiler is with the engine; but to determine the efficacy of the one by the power exercised by the other, would be contrary to all sense and science. Now, let us see how many circumstances are likely to interfere with the efficient action of both furnace and boiler.

*Causes Influencing the Quantity of Heat Generated.*—1. The state of the atmosphere, five to ten per cent; 2. The fire burning into holes, or unequally, and not attended to—five to ten per cent; 3. Irregular size of the coal lump, large and small—two to five per cent; 4. Inattention to removing the clinkers—five to ten per cent; 5. Variations in the draught and use of the damper; 6. Quantity of air admitted, and mode of admission.

*Causes Influencing the Quantity of Steam Generated.*—1. State of the flues,—clean or covered with soot; 2. Shape and size of the flues; 3. Extent of flue, or heat-absorbing surface; 4. Quantity of escaping heat,—that is, the rate of current; 5. Temperature of this escaping heated matter by chimney; 6, Temperature in the flues.

Again, what are the terms and circumstances which should enter into our calculation in estimating the value or effect of any system, or any particular boiler? They are—1. The weight of fuel employed; 2. The time taken for its combustion; 3. The quantity of heat generated; 4. The quantity of such heat absorbed by the water; 5. The quantity lost and escaping by the chimney,—that is, the current; 6. The temperature of the escaping products; 7. The weight of water evaporated.

In the case of the marine boiler experiments by Mr. Parkes, at times as much as 40 feet of the flue were filled with flame; and 12 feet of flame was the *minimum*. The flame from coke alone was never less than 10 feet long, and it became 20 feet when the fire was urged. Mr. Williams next explained a table, exhibiting the results of a series of minute and careful experiments, made by Mr. Josiah Parkes, on a marine boiler at Liverpool, during the preceding week.

[We propose giving the Table last alluded to by Mr. Williams, together with Mr. Parkes's report in our next.]

## THAMES STEAMERS—MESSRS. SEAWARD AND CO'S. NEW ATMOSPHERIC ENGINE.

Sir,—Having read in your truly esteemed and useful work of the 25th instant, No. 985, an account of the successful trial of a

new iron steamer, the machinery for which is made by Messrs. Seaward and Co., the highly respectable engineers at Limehouse, upon what may be termed the new-old plan, or, in other words, the atmospheric principle revived, I beg to observe, that, notwithstanding the admirable and satisfactory manner the engines are therein stated to have performed, that there are some inaccuracies in the statement—first, as to the distance from Blackwall to Gravesend—secondly, in having made that passage in less time than any other steamer. The distance from Blackwall to Gravesend instead of being 22 miles, as set forth by your correspondent, is, I believe, generally known to be under 20 miles, and this inaccuracy would, if admitted, give to the *Atmospheric** a fictitious speed in her favour of two miles in the hour, and really have a tendency to make her appear the fastest boat, and also to mislead the public mind. Of her having beaten the *Railway* steamer, I cannot either admit or contradict; if, however, it be so (notwithstanding the advantage, she would have, being at present little more than a shell in weight, without cabin fittings, stores, &c., while the *Railway*, in addition to the usual freight, was interrupted in her passage by stoppages to take in, and put out passengers on the way, which is not the case with a boat running an experimental trip) the *Atmospheric* has done well. Still the supposition that the *Atmospheric*, in having made the passage from Gravesend to Blackwall in 1 hour $7\frac{1}{2}$ minutes, is the shortest time in which the passage has ever been made is far wide of the fact, it being well known that each of the Blackwall Railway Company's boats, excepting the *Brunswick*, have several times performed the distance in one hour and from two to four minutes; and upon one occasion, it will be found upon reference to your Magazine of July 10, 1841, No. 935, as stated by "Justice" in answer to "Nautilus," on June 18, No. 933, that the *Blackwall* made the passage on June 11, in $58\frac{1}{2}$ minutes, which, I believe, is the quickest passage on record. Should the *Atmospheric* take a station on the Thames, fully equipped for service, and perform the passage in less time than the one by the *Blackwall* on the 11th of June, 1841, she will be justly entitled to be placed A 1; and yet it is hardly a question whether the novelty of the adoption of atmospheric agency will answer any very great end, or warrant by the bold attempt the hazard of public approval; perilled by the employment of a principle deemed by the great master mind incomplete, and for the remedy immortalized the name of Watt.

* Called so for distinction, not having, as yet, any name.

By giving this a place in your highly valued journal, you will greatly oblige a constant subscriber, and a lover of fair play, anxious that every one should have the just praise due to his merit. I am, Sir,

Your obliged and obedient servant,

VERITAS.

[We are obliged to our correspondent for setting us right as to the passage of the *Atmospheric* from Gravesend to Blackwall being the swiftest on record. What the distance really is—whether 20 or 22—matters nothing, so far as the comparison with other steamers goes. In the trial with the *Railway*, care was taken that the *Atmospheric* should stop every time the *Railway* stopped, and not resume her way till after her competitor had resumed hers. No doubt the fact of the *Atmospheric* being so lightly loaded was in her favour; but some allowance must also be made, on the other hand, for the newness of her engines, and (we may here add) for their not being very well secured to their bearings—a circumstance which caused palpably a great increase in the resistance which the steam had to overcome. As to the authority of Watt being unfavourable to this application of the atmospheric principle, we should think it of great weight if we did not remember, also, that he thought, for a long time, the navigation of the seas, by steam power in any shape, to be impossible.

In the description which we gave of the pistons, and the importance we ascribed to their peculiar form of construction, we took the enrolled specification of the invention, which was patented about two years ago, for our guide; but another correspondent (R. O.) informs us that the middle groove is *not* filled with steam, but with melted tallow; and this we find on inquiry to be the case. The same writer points out an obvious typographical error in the dimensions assigned to the floats, which are of course of the same area on both sides, namely, 9ft. 6in. × 11in.—ED. M. M.]

## H.M. FRIGATE "PENELOPE."

The operation of cutting this frigate in two, in order to her enlargement, and conversion into a steam-vessel of higher power than any yet afloat, (the intention to do which we were the first to announce two or three months ago—see *Mech. Mag.* for April 9,) was performed at Chatham Dockyard on the 18th ultimo. The following particulars of what took place on the occasion, we extract from the *Hampshire Telegraph.*

"Two large booths were erected on each side of the *Penelope*, and were filled by naval and military officers and the gentry of the neighbourhood. The sight was novel and astonishing. Three ropes were fastened to the gunwhale of the ship from three capstans, which were fixed in the ground facing the dock, and which were worked up by windlasses by nearly 200 convicts. On the arrival of the Rt. Hon. T. Cory, one of the Lords of the Admiralty, together with Sir W. Symonds, the surveyor, and Captain R. Brandreth, architect of the navy, Captain Superintendant Shirriff, and other officers, the master builder, Mr. Fincham, gave directions for all hands to work. As soon as the parts were observed to separate, the band of the dock-yard struck up, 'Oh dear, what can the matter be?' amidst the cheers of the assembled multitude. The fore part of the vessel was observed easily to glide up the dock. The fore part of the ship having been brought up to the mark allotted, left a space between the two parts of the ship, exactly 62 feet, which will lengthen her to about 190 feet."

### THE SOLAR ECLIPSE OF JULY 8.

Professor Silliman's *Journal of Science and Arts*, for January, 1842, contains an article "on the Solar Eclipse of July, 1842," in which it is observed—"As the approaching eclipse will excite great interest throughout Europe, and especially in those places where it will be total, it is earnestly hoped that particular attention will be paid by those favourably situated and in the possession of suitable instruments, to the determination of the correctness of a recent suggestion—that the irregularities so frequently noticed at the second and third contacts of nearly central eclipses, and at all the contacts of the transits of Venus, may be seen or not at the pleasure of the observer, according as the colour of the dark glass he applies to his telescope is red or green." The committee of the Philosophical Society of Philadelphia, in their report on this eclipse, remark, in reference to this suggestion of Professor Silliman, "The suggestion is one of the greatest importance, as it seems to furnish evidence of the existence of a lunar atmosphere, through which, as through our own, the red rays have the greatest penetrative power. It also leads to new views concerning the cause of the remarkable appearances of the beads of light and the dark lines frequently noticed, since it shows that their appearance may be completely modified by a change in the colour, and consequently in the absorbing power of the screen glass through which they are observed."

"It is believed," Professor Silliman further remarks, "that on another account will this suggestion, if well founded, be of great importance, viz., in its obvious tendency to diminish, if not wholly remove, the discordances not unfrequently found in the best observations on solar eclipses, and transits of Venus, and which, with regard to the latter in 1761 and 1769, were so great as materially to diminish the value of this method of determining the distance between the earth and the sun."

*American Horse-rake.*—In some parts of the country, where labour is very dear, they use a machine for raking the hay, called "the Flexible Horse rake." It is distinguished from all others by a joint in the centre of the head, by which the rake contracts to any uneven ground, and takes the hay clean. Also, by the form of the teeth, which glide over hillocks or stones, like the runner of a sled. This rake has also a smooth back-board, on a level with the teeth which support it; and it is not liable to become entangled with the hay, when canted over to be emptied. Twenty-four acres a day are raked perfectly clean with this instrument—one man holding it, a small boy riding the horse. The labour of managing it is less than that of holding a small plough.—*Le Cras.*

### LIST OF PATENTS GRANTED FOR SCOTLAND FROM 25TH OF MAY TO THE 23RD OF JUNE, 1842.

Joseph Clisild Daniel, of Tiverton Mills, near Bath, for improvements in making and preparing food for cattle. May 28.

Robert Logan, of Blackheath, Kent, Esq., for improvements in obtaining and preparing the fibres and other products of the cocoa nut and its husk. May 28.

Thomas Henry Russell, of Wednesbury, Stafford, iron-tube manufacturer, and Cornelius Whitehouse, of the same place, for improvements in the manufacture of welded iron tubing. May 28.

Thomas Middleton, of Loman-street, in the borough of Southwark, Surrey, engineer, for an improved method of preparing vegetable gelatine, or size for paper, and also an improved mode of applying the same in the manufacture of paper. (Being a communication from abroad.) June 6.

John Railton, of Blackburn, Lancaster, machine-maker, for certain improvements in machinery, or apparatus for weaving. June 6.

Thomas Hedley, of the town and borough of Newcastle-upon-Tyne, gentleman, and Cuthbert Rodham, of Gateshead, Durham, millwright, for an improved apparatus for purifying the smoke gases and other noxious vapours arising from certain fires, stoves, and furnaces. June 7.

John Burnell, the younger, of High-street, Whitechapel, Middlesex, manufacturer, for improvements in the manufacture of leaves or sheets of horn, commonly called lantern leaves, and in the construction of horn lanterns. June 8.

Otto Rotton, of Gracechurch-street, London, doctor of medicine, for certain improvements in machinery, or apparatus for spinning cotton, wool, and other fibrous substances. (Being a communication from abroad.) June 14.

John Bould, of Ovenden, Halifax, York, cotton-spinner, for an improvement or improvements in condensing steam-engines. June 23.

John Cox, of Gorgie Mills, Edinburgh, tanner and glue manufacturer, for certain improved process of tanning. June 23.

### LIST OF PATENTS GRANTED FOR IRELAND IN MAY, 1842.

James Hunt, for improvements in the manufacture of bricks.

William Newton, for an improved machine, or apparatus for weighing various kinds of articles or goods.

Edmund Morewood, for an improved mode of preserving iron and other metals from oxydation or rust.

Peter Kagenbusch, for an improvement in the dyeing of wool, woollen cloths, cotton, silks, and other fabrics and materials.

Henry Bewley, for an improved chalybeate water.

Sir James Murray, for an improved method of combining various materials in a manner not hitherto in use for the purposes of manure.

Edward Welch, for certain improvements in the construction of bricks.



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# Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 987.] SATURDAY, JULY 9, 1842. [Price 6*d.* Double.

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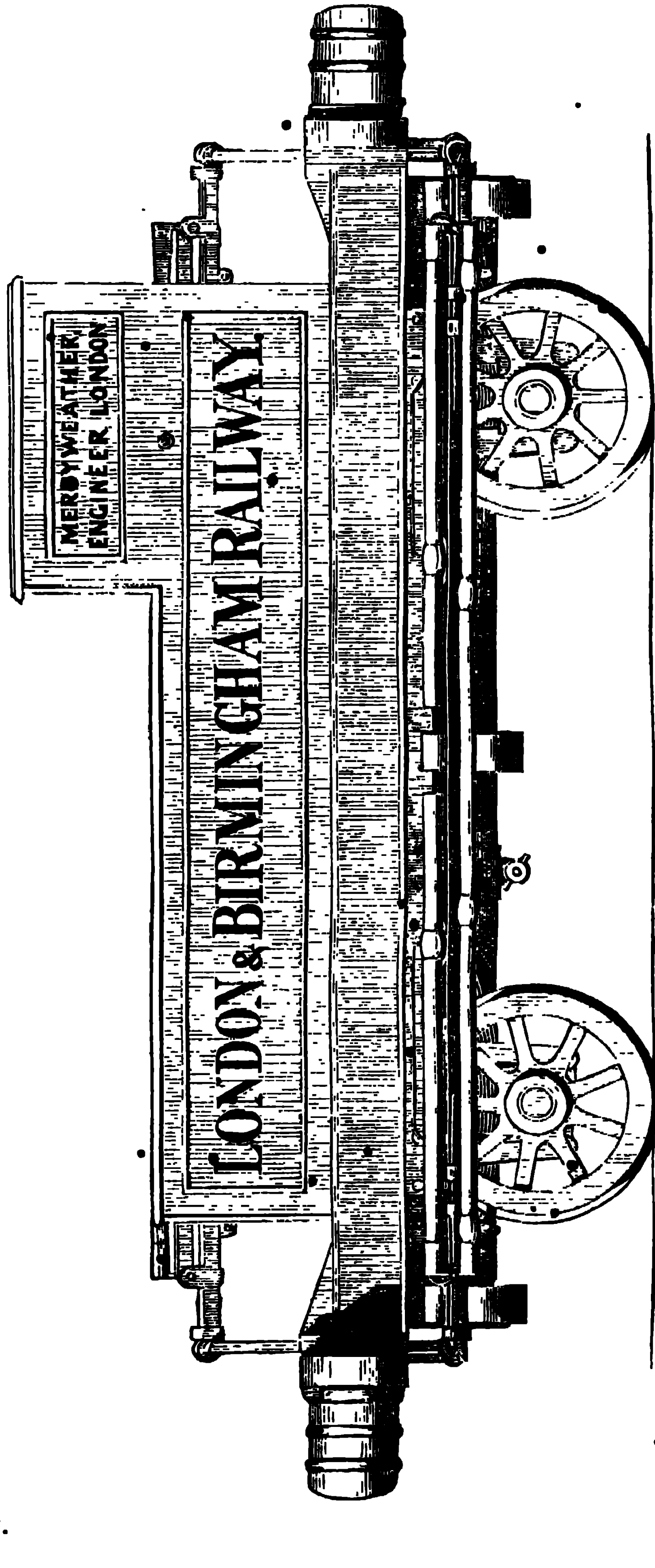


MERRYWEATHER'S RAILWAY FIRE-ENGINE.

## MERRYWEATHER'S RAILWAY FIRE-ENGINE.

Sir,—The accompanying drawing represents a powerful fire-engine recently built for the London and Birmingham Railway Company, by Mr. Merryweather, of Long Acre, London.

This engine is the largest ever constructed for land service in this or any other country, the celebrated steam fire-engine not excepted.

The pumps are two gun-metal cylinders, 9 inches in diameter, with a 10 inch stroke, and work into a spherical copper air-vessel, the capacity of which is nearly twenty gallons. The cistern, which is 13 feet long, holds, when full, four hundred and fifty gallons of water. The pistons and valves are of metal, the latter being placed in separate and easily accessible valve chambers; these excellent valves were fully described at page 325 of your xxviith volume. The water passages are 3 inches and a quarter in diameter. The handles when opened out are 23 feet long, but they fold up fore and aft, so as not to project beyond the length of the cistern; when extended they are kept straight by a sliding bolt of a simple and ingenious description.

Each end of the engine is fitted with spring buffers, attached to a buffer bar or frame, which is kept up by a pin-bolt, and hinged below so as to fall down out of the way of the handles and levers when the engine is set to work.

In the fore part of the engine is placed a hose-reel* capable of carrying upwards of ten lengths (*i. e.* 400 feet) of riveted leather hose, all joined up, the whole, or any portion of which can be run out and attached to the engine in a few seconds. In the pockets on either side are stowed away two lengths of suction-pipes, one long and one short branch-pipe, of the construction described at page 37 of vol. xxv.; with a complete set of nose-pipes, from an inch and a quarter down to three quarters of an inch in diameter. A leather *portable dam*, of suitable dimensions, with a proper complement of axes, crow-bars, wrenches, &c., complete the equipment of this stupendous engine.

A trial of this engine took place recently at the Euston-square Station before a number of railway directors, government officers and scientific gentlemen; the handles were manned by 42 of the railway servants, when a single jet, an inch and a quarter in diameter, was thrown in a compact form upwards of one hundred feet high; an inch and eighth jet was thrown considerably higher, and afterwards two jets of three quarters of an inch in diameter were delivered at similar elevations.

The trial took place under considerable disadvantage, from the deficiency of the present water supply, the small main from the Camden-town reservoirs being wholly inadequate to afford water with sufficient rapidity to meet the demands of an engine of this calibre.

The name of "Niagara" has been given to several tolerably powerful engines, but if ever it was appropriately bestowed, it would be on the Railway Fire-engine.

The London and Birmingham Railway Company have been tolerably exempt from accidental fires, and, when they have occurred, from the judicious precautions taken, have been promptly extinguished. The capabilities of the present engine, as regards working and travelling, are such, as to afford most sufficient protection to the extensive establishments of the Company at Camden-town, Wolverton, and other stations, as well as to all property adjacent to the line of railway. The performances of the engine, as well as the excellence of the workmanship, and the skill displayed in adapting it to the peculiar service for which it is intended, gave great and general satisfaction to all who saw it, and fully sustain the deserved reputation of Mr. Merryweather in this branch of manufacture.

I am, Sir,

Yours respectfully,

WM. BADDELEY.

29, Alfred-street, Islington, June 21, 1842.

* Described in vol. xxvii. page 31.

## MR C. W. WILLIAMS'S FURNACE AS APPLIED TO MARINE BOILERS.

Sir,—In sending you the following Report of experiments made by Mr. Parkes on a marine boiler, showing the difference between the old and new mode of effecting combustion in furnaces by the admission of air behind the bridge, I accompany the tabular view of Mr. Parkes's results by those of two other experiments with the same boiler and furnace—the one testing the new mode, under the circumstances of a slower rate of combustion, by heavy charges, and the other, with a reduced area of furnace. These results are highly instructive, and sufficiently prove the necessity of going further into the enquiry. In my next I hope to be able to give you some additional tables of the same character on this interesting subject, as laid before the British Association in Manchester.

| No. of Experiment. | Area of Furnace. | Area of Flue Surface. | Lbs. of Coal burned. | Hours occupied. | Lbs. of Water evaporated. | Lbs. of Water per lb. of Coal. | Temperature of escaping Products. |
|---|---|---|---|---|---|---|---|
| 1 | 7·16 | 300 | 158 | 1 | 653 | 4·12 | 515° |
| 2 | 7·16 | 300 | 224 | 1 | 1715 | 7·68 | 1193° |
| 3 | 7·16 | 300 | 149 | 1 | 1288 | 8·10 | 1080° |
| 4 | 6·25 | 300 | 112 | 1 | 1030 | 9·30 | 795° |

No. 1 and 2. Experiments by Mr. Parkes—the former, on the old system of excluding air from the gases behind the bridge—the latter, on Mr. Williams's plan of admitting the air.

No. 3. Experiment by a slower rate of combustion, with heavy firing—air admitted on Mr. Williams's plan.

No. 4. Air admitted and active combustion, the area of the fire-grate having been reduced.

These experiments show the difference between the old and new systems. They also show how little dependence can be placed on any test, drawn from the mere weight of water evaporated by each pound of coal. In the above, we see that the experiment which gave what would be considered the most economical results as regards the fuel, (namely 9·30lbs of water evaporated by each pound of coal,) was, in truth, the least economical, when *time* was taken into account. In this case, but 1030 lbs. of water were evaporated per hour, whereas, when the economy of fuel gave but 7·8lbs. of water per lb. of fuel, there were no less than 1715lbs. of water evaporated within the hour.

Thus we see that what would here have been called *economy*, might be the ruin of the manufacturer; for although each pound of coal would, *per se*, appear to do the largest work of evaporation, still, as less was done within the hour, it is manifest that, on the whole, less work would be done by the engine; and, as the weight of water evaporated within any given time may be taken as the representative of a given quantity of work done by the engine and the machinery it put in action, so the true measure of economy will depend, not on the quantity of water evaporated by each pound of coal, but on the time required for such evaporation.

The column showing the temperature of the escaping products (which are here for the first time, that I am aware of, brought into the account) is of the highest importance, since we find that, exactly in proportion as the quantity of water evaporated *per hour* was increased, so was the temperature of the products escaping by the chimney. This, although it is really so much extra work done by the fuel, has hitherto been overlooked; yet here lies, perhaps, the greatest source of practical available economy yet within our reach. Until we learn, therefore, how to turn this extra labour of the fuel to the work of evaporation, we are not in a position to determine, either the value of the fuel, or the description of furnace in which it may be best consumed.

In my next I hope to be able to lay before your readers the practical results of a mode of estimating the temperature of the flues of boilers, as laid before the Association by Henry Houldsworth, Esq., of Manchester. By this ingenious but simple plan, Mr. Houldsworth has effected what has so long been a desideratum, namely, the means of ascertaining not only the relative heating powers of different kinds of coal, but of the different

plans of furnaces in which they are consumed.*

I am, &c. &c.

C. W. Williams.

Liverpool July 4, 1842.

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REPORT ON MR. C. W. WILLIAMS'S PATENT FURNACE, AS APPLIED TO MARINE BOILERS. BY JOSIAH PARKES, ESQ., C. E.

*To the Directors of the City of Dublin Steam Company.*

Gentlemen,—Having been called upon by you, professionally, to examine the construction, management, and effect of Mr. Williams's Patent Furnace, as applied to marine steam-boilers, and to report thereon, I have to state the following results.

The experiments were conducted, during several days, on a boiler 15 feet in length, having a grate of 2 feet broad by 3 feet 9 inches long, the length of flue traversed by the heat being 40 feet from the grate to the foot of the funnel, and presenting a heated surface of about 300 square feet. This flue was surrounded on all sides by a water space in the usual way of marine boilers, and the boiler truly represented a section of those which commonly form the generating apparatus of a large steamer.

In order to obtain the value of Mr. Williams's method of inflaming the gases passing over from the fire, I first ascertained the weight of water which this boiler was capable of generating into steam under the ordinary working circumstances; that is, when no air was admitted except through the grate from the ashpit. The fire was carefully managed, and as much coal burnt of the grate during the day as the full draught of the funnel was capable of effecting. A continuous steam of smoke issued from the funnel, which varied only in its depth of black colour according to the quantity of gas and soot passing off unconsumed.

On the following day the boiler was worked on Mr. Williams's principle, no other change having been made than the opening of the air passages which communicate with the gaseous matter beyond the bridge. The results, from the commencement to the termination of this second experiment, were of a highly interesting and satisfactory nature. Scarcely a trace of smoke was visible at the summit of the funnel, except at the instant of firing or poking the fire. On inspecting the flues through the various sight-holes pierced for that purpose, and by which I was enabled to see every part of the interior, the gases were found to be converted into perfectly bright flame, and there was no deposit of carbonaceous matter. The evaporative power of the boiler was considerably increased, arising in part from the increased draught produced by the ignition of the gases, and in part from the heat occasioned by their more perfect combustion. A difference of 47 per cent. resulted in the weight of water vaporized, per pound of coal, in favour of Mr. Williams's process.

This large increase in evaporative economy and power, obtained from the mere ignition of the gases, might surprise persons unacquainted with the structure of marine boilers; but it is readily accounted for. The flues of such boilers are altogether immersed in water, and, if combustion be not complete, become rapidly coated over with soot and tar, (which was the case in the first day's experiment,) and these substances impede, to a great extent, the transmission of heat through the metal. At no one period, during the working of the boiler on the common plan, was I able to discern, through the sight-holes, a ray of light in the flues: a densely black current of gas and smoke occupied them. On the second day, the flues were constantly filled and traversed by brilliant flame, or clear transparent heated gaseous products of combustion, and the thermometer, at the foot of the funnel, indicated a temperature in these escaping products more than double that marked on the first day. This is, necessarily, so much waste heat; but, unfortunately, the space assigned to boilers in steam-boats will not frequently permit so extended a surface to be exposed to imbibe the heat and transmit it to the water as is requisite to obtain the greatest economy in the use of fuel.

During the above-named and other experiments, I made numerous essays of the effect produced by shutting off the admission of air to the gases behind the bridge, after the *visible* inflammable gases, such as carburetted hydrogen, had ceased to come over, and when the fuel on the grate was clear and incandescent. In such cases, I always found the entire stoppage of air to be followed by diminished heat in the flues and by diminished evaporation; for, at these times, carbonic oxide continued to be evolved—a gas which, though colourless, was convertible, by a due mixture of the atmospheric air, into flame, possessing evidently a high intensity of heat and producing much useful effect. The calorific value of this gas is lost when the air is excluded, although its non-combustion is not attended with the production of visible smoke.

The consequences of regulating and vary-

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* Some notice of the Association transactions referred to by Mr. Williams will be found in a subsequent part of our present Number. Edit.

ing the quantity of air admitted, so as to suit the varying state of the furnace as regards the quantity of gas given off, also occupied my close attention, and are important for you to know. It is quite certain, that, in order to effect the perfect combustion of all the combustible gases produced in a furnace, a large demand for air (distinct from the air entering the grate) always exists; also, that, by entirely excluding air from behind the bridge, smoke is produced in certain states, and the heat is diminished in all states of the fire. Thus, with correctly assigned proportions once ascertained, no attention is required, on the part of the fireman, in regulating the admission of air; for, though it is certain that by a nice adjustment of air to the various gases the effect would be increased, such attention is inconvenient and practically unnecessary, since, in all states of the fire, under the circumstances of rapid combustion practised in marine boilers, air is constantly required for those gases. The experiments were quite satisfactory on this head, that, to a certain and not inconsiderable extent, the quantity of air entering the diffusion bridge adjusts itself to the demands of the gas coming over; and this it is which renders the regulation of the air by the fireman unnecessary, just as the quantity of air requisite for perfect combustion in the Argand Lamp adjusts itself, within all practical limits, to the quantity of gas at any time in action, according to the desired length of flame. On looking through the sight-holes, it was manifest that, as a stream of either carburetted hydrogen or carbonic oxide gas was at all times generated and passing over, so there was necessarily and at all times a corresponding demand for air, and, when supplied, a continuous stream of visible flame, the minimum length of which was from 10 to 12 feet beyond the bridge.

There yet remains one other point of some moment to advert to. An inspection of the whole process of combustion, and of the absorption of heat, so completely afforded by the sight-holes, offers convincing evidence that the temperature, or intensity of the heat developed in different portions of the first or fire flue, is very uniform. The inflammation of a current of gas is a continuous, not a momentary, process; nor is it confined to any one spot. It would be difficult to assign the place of maximum temperature when large quantities of gas are coming over, as it necessarily varies with the nature and bulk of the gases evolved, as does also the length of flame produced; which, in these experiments, sometimes extended through 40 feet and entered the funnel; whilst, at other times, the flame did not exceed 12 feet in length. So far as brilliancy of light can be considered as an index of intensity of heat, every observer of the process will be satisfied that the most luminous aspect of the flame exists at the distance of many feet from the place where the air is admitted, and not until after a perfect incorporation of the air and gases has been effected. These remarks may, possibly, serve to dissipate an idea which has long been nourished and is even still propagated by inexperienced persons, viz., that the inflammation of gas under a boiler *after* it quits the fire-place (*not before*) is injurious to the metal, or, as they suppose, tends to *burn the boiler*. How such an effect can be produced, while the vessel contains water and is in clean condition, has not yet been attempted, rationally, to be explained. It is well known that an approximate equilibrium of temperature obtains with wonderful rapidity amongst all aëriform fluids where motion or communication is unimpeded; and, in the case of the flues of steam boilers, the motion of the particles of heated matter, as well as the absorption of heat, is far too rapid for the determination, to any particular spot, of an intensity of heat likely to be prejudicial when the vessel is clean and a proper circulation of the water is provided for. An ocular inspection of the combustion of coals in boiler furnaces cannot fail to satisfy the most sceptical person that a far more uniform temperature exists in the fireplace and flues, when using Mr. Williams's, than in the common process.

I have alluded to the great waste of heat escaping through the funnels of marine boilers, when pressed, as they frequently are, from contracted dimensions, to afford the greatest possible quantity of steam in a given time. A great corrective of this waste seems likely to result from the introduction into the flues of Mr. Williams's conducting pins, trials of which, to some extent, have proved satisfactory. As this, however, is a subject distinct from combustion, and as Mr. Williams is arranging the means of submitting the invention to exact investigation in marine boilers, I propose to make it the subject of another report.

I enclose the details of the present experiments, and remain,

Gentlemen, your obedient servant,

JOSIAH PARKES.

Westminster, 7, Great College-street,
May 30, 1842.

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## METHOD OF IMITATING MAPLE AND OTHER FANCY WOODS.

SIR,—I beg to send you a description of a method invented by me of improving the appearance of most common woods, as plane, birch, and the like, so that they

may be employed in veneering and beautifying the most costly cabinet work, &c.

The wood is first sawn into sheets or slips of about one-eighth of an inch in thickness; this done, they must be pressed between two warm metal plates, having corresp·nding grooves cast on the surface, resembling waves (and fitting accurately when placed together); the sheets of wood must be kept between them until they have properly set and become firm, when they may be taken out, and, after the inequalities have been planed off and made smooth, the texture and appearance will be precisely that observed in the finest and most beautifully figured maple; the richness of the latter arising entirely from the form and disposition of the fibres.

If a strong pressure be at command, the sheets of plane-tree may be made very considerably thicker previous to undergoing the process just described, so that they may be afterwards sawn into two or three separate veneers, instead of one only being produced,

Your obedient servant,
T. W. NAYLOR

Newcastle-upon-Tyne.

## PRACTICAL GLEANINGS FROM THE TRANSACTIONS OF THE MANCHESTER MEETING OF THE BRITISH ASSOCIATION. JUNE, 1842.

[The following notices are chiefly derived from Reports of the Meeting which have appeared in the *Manchester Guardian*, and which, for their great extent and general accuracy, do much honour to the provincial press. When taken from other sources, these sources will be found also duly acknowledged.]

### MAGNETIC AND METEOROLOGICAL OBSERVATIONS.

Sir *John Herschell* made a report on the great system of magnetic and meteorological co-operation, which, three or four years ago, was commenced by the British government, at the instance of the British Association, and which is by far the greatest combined scientific operation the world has ever yet witnessed. After noticing the vast increase and extension of the surveys and observations, the report referred to the Antarctic expedition, taking it up where the report of last year left it, at Hobart Town, in 1840. Captain Ross observed the November term [for observations] in 1840, at the Auckland Islands. Though (according to observations which had lately reached England) Captain Ross was still to the east of the greatest intensity, the intensities observed by him in those regions exceeded by $2\frac{1}{2}$ the minimum of the observations made by him near St. Helena, on his outward passage. The Admiralty (who had rendered every service to these inquiries) had placed under the care of Col. Sabine the observations made on board each ship by Mr. Fox's instrument, the results of which were most satisfactory, as regarded the observations at sea; for out of 647 observations of this kind made between London and the Cape, on board the *Erebus* and *Terror*, one only had been declared doubtful; while the observations taken by both ships exhibited a steady accordance, that could not be accidental, and might well be called beautiful. It would appear, that the line of least intensity in successive meridians is travelling rapidly northward. The terms of November, 1840, had been kept (by Captain Ross) at the Auckland Islands; those of May and June, 1841, at Van Diemen's Land; those of July, at Sydney; later terms had been kept in New Zealand; and the November terms in the Bay of Islands; and, from a letter from Captain Ross, dated 22nd November, 1841, it appeared that the expedition was to sail the day following, to resume the investigation; and it was his intention to traverse the isodynamical oval, which was supposed to be in latitude 60° south, commencing in longitude 10° and latitude 52° 53′ south; and it was his intention to pursue the frozen barrier wherever it was accessible; the working out of which intention might of course involve another winter, spent within the Antarctic zone. Should it be otherwise, we might expect ere long to hear of his arrival at the Falkland Islands; but, in the other alternative, another year would elapse without any further tidings of the expedition. As to *British and foreign observatories*, the British and Indian stations, except that at Aden, had long been in full activity. The Russian government had been pre-eminent in the aid given, supported by Mr. Cankrien, minister of finance, as well as aided by the funds placed at the disposal of the parties conducting these observations by Prince Menzikoff. Amongst other things noticed were the re-erection of an observatory at Tiflis; the erection of a new one at Moscow, under the care of Count Strogonoff, curator of the university of that city. These operations, conducted by every European power, had occupied much time; the original term granted by our own government and the East India Company expired in the current year, just when the arrangements were completed over a great portion of the world, and the fruits were beginning to be gathered in. Accordingly, application was made to government by the president and council of the Royal Society, for their continuation for another period of three years, to terminate

in 1835; and at the same time it was officially stated, on the part of the Russian government, that the observatories in that empire should be kept up as long as the British ones, Baron Brunow stating, that this extension was the shortest adequate to obtain results to repay the outlay. The British government gave an unhesitating assent to the continuation of the present scheme for three additional years. For this new period the past had been an excellent preparation; all improvements that experience could suggest would be adopted; hourly instead of two-hourly observations would be made, and hourly magnetic corrections might henceforward be accurately determined and confidently applied. But the past had not been merely a season of preparation; it had afforded demonstrations of the ubiquity of those singular disturbances called magnetic storms, which could not otherwise have been obtained, -data, which afforded numerous proofs in support of the truth of the Gaussian theory. As to *magnetic surveys*, in South Africa, Lieutenant Clarke, R.A. had joined the observatory at the Cape, as assistant to Captain Wilmot; and it was proposed that the survey should comprehend, in addition to the colony, as extended a portion of the earth's surface, from the observatory, as circumstances would permit. The Admiralty had instructed the admiral on the station to permit the sea portion of the survey to be carried into execution, so far as it was not prejudicial to the service, in her Majesty's vessels, and these surveys would include the coast on each side the Cape; and then we should be better able to judge of the expediency of completing the survey by an expedition into the interior. The Geographical Society had furnished a notice of a great lake in the interior of Africa, the existence of which was ascertained, but which had never been visited by Europeans. In North America, Lieutenant Lefroy had been appointed to the principal observatory at Toronto; he was now in England preparing instruments, and would proceed thither in a few weeks, to assist Lieut. Younghusband, in the observations conducted on the excellent system of Mr. Riddell. The Hudson's Bay Company had liberally undertaken to furnish conveyances in the years 1833-4 and 1835, to extend the surveys to the Pacific Ocean, and they also made an offer of passages on board their annual ships to England; and this would enable them to include in this magnetic survey Hudson's Bay and Straits. In the United States, Professor Bache (of Philadelphia), during the last summer, had completed the survey of Pennsylvania commenced in the previous year, including three series of observations—the declination, inclination, and survey. These and numerous other observations and surveys in the States would connect the northern British survey with the determinations of Captain Barnett, of the *Thunder*, in the Gulf of Mexico. As to *observations at sea*, by the use of Mr. Fox's instrument the inclination and dip of the magnetic intensity might be measured with a precision quite as great as requisite for every possible use to which observations at sea could be turned, for the purpose of tracing out the isodynamic and other magnetic curves in portions of the globe covered by water. To extend and facilitate the use of this valuable instrument, the set of instructions drawn up by Colonel Sabine had been printed by order of the admiralty, as a general circular, with some statements of the mode of using it practised on board the *Erebus* and *Terror*; and the hope was expressed, that this method would be followed, not only in exploratory voyages, but by ships pursuing ordinary tracks, so as to furnish data for complete magnetic sea-charts. For these important observations, as well as the declination, it was necessary to eliminate the quantity of ship's iron—an evil increasing from the greater quantity now used. After noticing the observations of Captain Belcher, of the *Sulphur*, on more than twenty islands in the Pacific seas, which had arrived in England, and would be published, and the important results deduced from M. Erman's magnetic journey in Siberia, the report noticed the subject of *magnetic disturbances*, respecting which Gauss remarked, that one of the results of this British enterprise was that the existence and extension of these disturbances over the whole of the globe had been ascertained. As a physical fact, this was indeed a result of the first magnitude; and considering all the circumstances, how it was modified by distance and locality, was eminently calculated to lead to theoretical truths. It distinguished what was local from what was general, and traced individual shocks from observatory to observatory, and station to station, till they were so far enfeebled as to be confounded and masked by the growing influence of other shocks nearer the principal point of observation. The report recommended smaller bars than those now in use, as more easily affected by sudden shocks. It was now considered advisable to collect from all sources to which we had access, accounts of the remarkable disturbances beginning with 1840 and 1841, arranging them in chronological order, and publishing them in volumes by themselves; and the first volume would be published in the course of this summer. The great disturbance of the 12th of September 1841, which was observed at Greenwich, and was immediately

made the subject of a circular from the astronomer-royal to his brother observers, was also observed at Toronto, the Cape of Good Hope, Cape Drummond, and Travancore. The reports from all these stations arrived in time to be inserted in the volume for 1841; and surely it might be regarded as a remarkable fact, that this phenomenon was seized upon by our observers in Europe, Asia, Africa, and America, reduced to determination, and printed in three weeks after the arrival of the observations in England. The returns from the different stations, showed, that these disturbances were general; that, though the movements individually might not be, and in fact, were not always, simultaneous, the observations on the same day never failed to exhibit unusual discordances at all the stations, and were generally characterized by the diminution more or less of the horizontal intensity, prevailing more or less for several hours every where, and the movement of the north end of the needle towards the west. Besides the colonial observatories, these phenomena were watched with great attention at the observatories of Prague, and Munich. The report next noticed the new magnetic instruments and modes of observation. We can only enumerate the former, viz.--the transportable magnetometer, Dr. Lloyd's induction inclinometer, Weber's inductive inclinometer, and another method proposed by Dr. Lamont. The report next enumerated the publication of various magnetic observations, and descriptions of observatories during the year. The only expense incurred by the Association, during the year, was 10*l.* 8*s.* 10*d.* for observatory registers; and the committee prayed a further grant. [A grant of 89*l.* 11*s.* was afterwards voted.]

STANDARD WEIGHTS AND MEASURES.

*The Rev. Dr. Peacock, dean of Ely*, after stating that the Imperial Standards of Weights and Measures, (the yard, the pound, the gallon, and several of their multiples,) had been lost in the fire which destroyed the two houses of parliament, mentioned, that a commission of which he was a member, had been appointed to report on the best means of restoring these standards. The standard pound weight was Troy weight (5,780 grains,) though the pound avoirdupois (7,000 grains) was used throughout the country, in the proportion, perhaps, of 10,000 to one of Troy. The commission recommended the standard pound to be the representative of the avoirdupois, and not (as before) of the Troy pound; that, hereafter, the use of the Troy pound should be abolished, except for a very limited number of transactions, and that the avoirdupois pound should be considered as the standard pound of Great Britain. They recommended that measures of capacity should be determined by measures of weight,—by far the most convenient method, inasmuch as weighing was a much more accurate operation, than, for instance, the formation of a perfect cube. The commission also ventured to recommend strongly some alterations in the coinage, and the systems of weights and measures, arising out of a more extensive introduction of the decimal scale. The nearly unanimous determination of the commission was, that any attempt to interfere materially with the primary units of the coinage, weights, and measures, in ordinary use, would produce such confusion and bad consequences in the ordinary transactions of life, that they would adhere strictly to all those primary units, viz. the pound sterling of our coinage; the yard in the measure of length (and also the foot, for there were two primary units in this measure;) the acre, in the measure of areas; the gallon, in the measure of capacity; and the imperial pound, in the measure of weight. As the coinage must necessarily be the basis of any changes leading to the more extended adoption of a decimal scale,—Taking the pound sterling as the primary unit, they proposed to introduce a coin of the value of 2*s.* (one-tenth of the pound;) another, either silver or copper, of one-tenth of 2*s.* (or 2*d.* and a fraction) which might be called a *cent* (the hundredth of a pound) and the thousandth part of the pound sterling, or nearly the value of our farthing, (of which there are 960 in the pound,) which new coin it was proposed to call a *millit* (from thousandth.) The difference in the value of the copper coinage was less important, as it was merely a representative coinage, and had not an approximating intrinsic value like the gold and silver coinage. For the proposed coin of 2*s.* various names had been suggested, as *Victorine*, rupee, and florin; it being not much different from the value of some of the rupees of the East Indies, or the florin of the Continent. Under this new decimal scale, the shilling would be retained, and also the sixpence, (but the latter under another name, more representative of its value.) For the half-crown would be substituted the 2*s.* or *Victorine*. The very rev. gentleman dwelt at some length on the advantages of this change, in the extensive money transactions and accounts of bankers and merchants; in the Bank of England, for instance, where a thousand clerks were employed, where it would greatly facilitate the operations of calculation and book-keeping. Thus discarding *millets* (for bankers now excluded the subdivisions of a penny in their accounts,) the sum of 17*l.* 3 *Victorines, 7 cents* would be represented at once by 17·37; only

two places of decimals, instead of as now in pounds, shillings, and pence. He showed how the principle was applicable, with still greater advantage, in cases of weights and measures (where the scale was now most anomalous and absurd.) Suppose the rental or value of 30·61 acres of land to be required, and that the land cost 69*l.* 3 *Victorines*, 4 *cents* an acre. The reduction in common arithmetic was one of very considerable labour, difficulty, and time. Indeed, if this decimal system were adopted, the labour of teaching arithmetic to school boys would be reduced nearly one half. But, by this plan (as the rev. doctor showed,) the result might be obtained in five lines of decimals, containing only 27 figures. As to weights, the most extensive change recommended by the committee, would be to introduce the uniform weight of 10lb. to the stone, instead of the varieties of 8lb. in some, and 14lb. or 16lb. in other parts of the kingdom; the hundred weight to be called *centna* (a German term.) These were all the changes proposed in weights; the commission not wishing to interfere with the subdivision of the pound, which admitted of four subdivisions into 8oz. 4oz. 2oz. and 1oz. The pound and ounce would remain therefore, exactly the same as at present. As to the measure of length, the commission thought it too violent a change to alter all the milestones; but there would be no difficulty (with reference to the standing orders of parliament, in railway matters, &c.) to introduce the measure of 1,000 yards, which might be called a mil*yard*.

STRENGTH OF STONES AND OTHER MATERIALS.

*Mr. Eaton Hodgkinson* noticing the present state of knowledge, (we might say, of comparative ignorance) on this subject, and the experiments of Barlow, Rennie, and of some experimentalists on the Continent, said, he had long felt anxious to ascertain how the three forces—the crushing, the tensile, and the transverse strength—and the position of the neutral line—(that separating the extended and compressed fibres in a bent body)—were connected in bodies generally; and his experiments had for several years been directed to discovering facts upon each of these matters, in order to determine the question. His experiments some years ago, made for the British Association, with respect to the values of hot and cold blast iron, had shown that the ratio of the forces of ultimate tension and compression was nearly constant in all the species of cast iron; and a few experiments made at that time on sandstone and marble, had led him to suspect that nearly the same would be the case in these and other hard bodies. Through the permission of his friend Mr. Fairbairn, he had made a great many experiments upon wood, sandstones, marbles, glass, slate, ivory, bone, &c.—to ascertain the tensile, crushing the transverse strength of each; also, as far as possible, the situation of the neutral line, in thirteen different kinds of timber, (including oaks, pines, teak, &c.) All the three sorts of experiments were made as far as possible out of the same specimen in each case, to render the result as unexceptionable as they could be made. The wood was of good quality, and perfectly dry, having been chosen for this purpose, and laid in a warm dry place for four years or more. Previous to experiment, the bars of wood were all reduced with care to the same dimensions, and afterwards weighed, to ascertain the specific gravity. They were then laid upon supports, to obtain the deflections with given weights, and the breaking weight with its deflection. The two portions into which a specimen was broken were afterwards reduced in the middle by the lathe to the form used in Mr. Barlow's experiments, in order that the experiments might be torn asunder in the middle, by a force acting directly through the axis, and thus to obtain the tensile strength of the wood. Afterwards, the thick ends of the specimens were turned by the lathe into cylinders, all of the same diameter and length, as nearly as practicable, and their exact dimensions afterwards taken, in order to ascertain by experiment the resistance of the woods to a crushing force. After describing the character and results of his experiments on the various substances named above (specimens of which he produced,) Mr. Hodgkinson gave the following summary of results of very numerous experiments on marbles and stones of various degrees of hardness:—

| Description of stone. | Crushing force per square inch called 1,000. | Tensile force per square inch. | Tranverse strength of bar 1 inch square and 1 foot space. |
|---|---|---|---|
| Black marble | 1,000 | 143 | 10·1 |
| Italian marble | 1,000 | 84 | 10·6 |
| Rochdale flagstone | 1,000 | 101 | 9·9 |
| High Moor stone | 1,000 | 100 | |
| Stone called Yorkshire flag | 1,000 | | 9·5 |
| Stone from little Hulton, near Bolton | 1,000 | 70 | 8·8 |
| Mean Rates | 1,000 | 100 | 9·8 |

Mr Hodgkinson gave the following recapitulation of results:—Calling the mean crushing strength per square inch, in the different articles experimented upon, 1,000, we have,—

| Crushing strength, 1,000. | Tensile strength. | Transverse strength. | Ratio of mean transile to one strong force. |
|---|---|---|---|
| In timber ........... 1,000 | 1900 | 85·1 | 1·55 |
| Cast iron............ 1,000 | 158 | 19·8 | 1·66 |
| Glass (plate and crown) 1,000 | 123 | 10· | 1·78 |
| Stone and marble .... 1,000 | 100 | 9·8 | 1·10·5 or 1·8·9 taking the hardest only. |

The ratio of the crushing force to the transverse force is nearly the same in glass, stone, and marble, including the hardest and the softest kinds. Hence, if we know the transverse strength, or the crushing strength, in any of these bodies, we may predict the other; and as glass and the hardest stones resist crushing with from seven to nine times the energy that they do being torn asunder, we may get an approximate value of the tensile force from the crushing force, or *vice versa*. These results render it probable, that the hardest bodies, whether cast iron, glass, stone, or marble, admit of certain atomic displacements either in tearing asunder or crushing; these displacements being in a given ratio to each other, or nearly so. In future calculations as to the strength of bodies, the crushing strength ought to be made the fundamental datum, for the reasons shown in this notice. The ratio of the transverse strength to the crushing strength is greater in cast iron than in glass, marble, and sandstones, arising from the ductability of that metal. The necessity of enlarged inquiries in these matters will be seen, when it is reflected that calculations of the transile strength of cast iron, or marble, or stones in general, made from the tranverse strength by the modes used by Tredgold, Navier, and others, give the transile strength, twice or three times as great as it ought to be.

## NEW AND EASY METHOD OF ANALYZING SUGAR. BY DR. DALTON.

The new method of analyzing sugar is this. Dr. D. exposed 100 grains of sugar for half an hour to a heat of 270° or 300° Fahrenheit: it was beginning to become fluid, about 2— grains; but the rest was solid, and a little browned. The doctor has a bottle that holds 572 grains of water up to the neck, and a nicely ground stopper, so as to be wiped clean and dry: this is to be filled with distilled water, and then poured into a convenient glass with a spout to it, that it may be reconveyed into the bottle again. One hundred grains of double-refined sugar, carefully weighed, are to be poured into the glass, and stirred about with a very slender stick of glass till it is all dissolved. It is then to be reconveyed into the bottle, taking care that there is not a drop lost; a little dexterity is required, but it is easily managed; the glass rod is to be regarded, and the best way is to stroke the glass rod till it is clean and dry. Then the remainder is to be poured into the narrow tube, and the number of grains is then read off. The narrow tube is to measure the grains of water and sugar overplus, or water itself, which is the same measure. The doctor generally used 100 grains for the prime experiment.

| | | |
|---|---|---|
| | 100 | sugar grains, dissolved in |
| | 572 | water grains, |
| | —— | |
| gave | 672 | grains by weight. |
| In specific gravity bot. | 606 | grains. |
| In narrow tube | 66 | grains. |
| | —— | |
| | 672 | grains by weight. |

The specific gravity bottle did not vary more than 606 or 607, or one grain at most. It was long known that sugar was disposed to resolve itself solid and liquid. The solid part is charcoal, and the liquid part is water. 100 grains of sugar in 572 water were exhibited crystallized; it is very differently crystallized, and yet is the same weight as before; 100 East India sugar has a superabundance in charcoal half a grain; 100 West India sugar has also a superabundance of charcoal one grain. The doctor concluded this paper by giving the atoms which form sugar, tartaric acid, acetic acid, vivic acid, and citric acid. The *experimentum crucis*, after all, is in the following example:—Take 100 grains of sugar, dissolve it in 100 water, which will just melt it (after stirring about awhile with a small glass rod); then pour it out into a glass measure of upwards of 160 grains; it will be found 157 grains precisely. The 57 grains of pure water have arisen out of the sugar, and the 43 grains remain in, buried invisibly in the pores of the water. This follows, as all solid bodies remain in fluids, adding to the weight and not to the bulk of them as previously explained. The venerable doctor here rose, and showed his apparatus and simple *modus operandi*, entering into the details of the demonstration with remarkable eagerness and interest. He was assisted in the experiment by Mr. P. Clare, who explained the doctor's views with great clearness.

## THE TELESCOPE—MULTIPLICATION OF SPECULA BY MEANS OF THE ELECTROTYPE.

*Mr. Fox Talbot* read a long paper on this

subject. It had first occurred to him about two years ago, when the Earl of Rosse (then Lord Oxmantoun) was making much larger specula for reflecting telescopes than had ever been obtained before; and he thought, if once we had a very large and perfect speculum, it might be possible to multiply copies of it by means of the electrotype,—by galvanic means taking an electrotype cast from the existing original at a small expense, —which, if not quite so perfect as the original, should be at least very fine and important instruments. He had observed, that if an electrotype cast were taken from a perfectly polished surface, the cast was also perfectly polished; so that no defect of form from this cause could have an injurious effect on the speculum. The great and obvious defect was, that electrotypes being in copper, which reflected but little light, a very large speculum of copper would not reflect more light than a very small one in speculum metal. He mentioned these ideas to Professor Wheatstone, who said the same had occurred to him, and he showed him a paper which he had drawn up some few months before, and which he lent him. Mr. Talbot read this paper of Professor Wheatstone's, in which he suggested the taking galvano-plastic casts of specula in platina, palladium, silver, or nickel, and for especial purposes gilding the copper; taking care that the two precipitations adhered well to each other. He suggested that voltaic electricity might thus enable us to copy large specula (like those of Lord Oxmantoun), at a slight expense. So that (said Mr. Talbot) the idea had suggested itself independently to both of them; but on comparing notes they found differences. Though it had occurred to him (Mr. Talbot) to precipitate white metals, yet he did not think that platina would have a sufficiently beautiful white metallic polish. Silver he rejected, because easily oxydated by the atmosphere. Nickel he had not tried, but it appeared likely to answer. Professor Wheatstone had, however, made choice of platina, and, varying the quantity till he found the required proportion, he obtained a mirror in platina which appeared to him (Mr. Talbot) to have quite brilliant polish enough, and to be white enough to answer the purpose; and he considered, therefore, that Professor Wheatstone had proved, that, at least in one form, the specula of telescopes might be made by voltaic precipitation. His own idea was, that it might be possible to whiten the surface of the copper without injuring the form; and, therefore, having obtained a speculum in very bright polished copper, he exposed it to the vapour of the hydro-sulphuret of ammonia, which had the property of turning copper white; and it did so, without, so far as he knew, in the least injuring the form of the metal. A copper speculum was subject to two evils; it reflected but little light, and it became easily tarnished; but, when whitened by exposure to the hydro-sulphuret of ammonia, the surface was transformed into a sulphuret of copper, and not only was a white metal obtained, but it was no longer subject to be tarnished by the atmosphere; the sulphuret of copper being a stronger chemical compound than the oxide of copper, and, consequently, oxygen had no more effect upon it than on platina. Having obtained a copper cast from a polished speculum, he (Mr. Talbot) whitened it, and transformed it into sulphuret of copper; and, after having retained it about a year, he did not perceive the smallest alteration in any respect. This, therefore, appeared to him a mode by which such important results for astronomers could be obtained. For the last year, perhaps, nothing further had been done, either by Professor Wheatstone or himself; but the other day, being at Munich, he (Mr. Talbot) visited Professor Steinheil, who showed him his inventions, and told him he had invented a method of making specula by the electrotype. It so happened, that both Professor Steinheil and himself had published their respective methods about a month or six weeks before; the professor having read a communication on the subject before the Academy of Sciences at Munich, and printed it, and he (Mr. Talbot) having published his in England. Their modes were, however, different, as Professor Steinheil precipitated gold upon the speculum of copper; and, having precipitated a certain thickness of gold, he then precipitated copper on the back of the gold, to give it sufficient thickness. He (Mr. Talbot) should have thought beforehand that gold would not reflect light enough to be available; but Professor Steinheil informed him he had found, by careful experiment, that it reflected more light than polished steel. He allowed Mr. Talbot to look through a Gregorian reflecting telescope, of which the speculum was a common one, but gilded, and he found the image perfectly clear and well defined. A slight tinge of yellow was thrown over all the objects, but the image was perfectly clear and defined. Now it was evident, that if the form of the speculum were not destroyed by gilding it, much less would it be altered if formed originally of gold. If a film of gold were precipitated upon a speculum of copper, we must, to a certain extent, alter its figure; but that alteration must be very small, because there was no perceptible defect in the image. Professor Steinheil said, that the astronomers of Germany were much pleased

with his plan, and were greatly engaged in the subject; and that in the course of a year he should have a very large telescope, furnished not only with a speculum, but also with other apparatus, voltaically formed, so that telescopes might be made all from a good model, so as to insure greater accuracy of proportions; and in this way even very large telescopes might be constructed at a comparatively trifling expense. With reference to the precipitating copper on the back of the gold, the professor had a simple expedient for securing adhesion. He first precipitated gold from the cyanide of gold, and he mixed with it cyanide of copper, and kept gradually increasing the quantity of the latter sort; so that an alloy was precipitated, which was continually increasing the copper with respect to the gold, till he had a speculum whose surface was gold, and which then became an alloy, the quality decreasing, till, at the bottom, it became pure copper. This was important; because, without such experiments, one would not have known that such results would have followed; for some philosophers supposed, that, if we attempt to precipitate the salts of two metals, only one is precipitated; but Professor Steinheil informed him that they precipitated in union. He thus obtained a speculum with a face of gold and a back of copper. But, supposing the largest, cheapest, and best speculum were obtained, the framework of the telescope would be so gigantic, that few observers would be able to use the instrument. With a focal length of 60 to 80 feet, it would be quite unmanageable for any private individual. The idea occurred to him (Mr. Talbot) to have a tube fixed in an invariable position, and to have a perfectly true plane mirror, of a size somewhat larger than the concave speculum, placed in front of the tube, with an aperture in the centre. This plane reflector should be moveable about its centre in any direction; so that luminous bodies, falling first upon the plane reflector, were then reflected against the concave reflector, and passed through the aperture. The only motion requisite for the plane mirror would be one about its centre. The mechanical difficulties in the way of this plan would be far less than in the common method. Professor Steinheil's idea on this point was somewhat different. He (Mr. Talbot) did not think it important in what direction the tube of the telescope was directed. Professor Steinheil's idea was, that it should be pointed directly to the pole of the heavens, and kept as steady as possible, and that the plane mirror should have a simple motion of revolution, indeed two motions, but about a rectangular centre.

## CHRONOMETERS.

*Mr. Dent* reported 'On his Chronometrical Experiment to determine the difference of Meridians between Greenwich and Devonport.'—The following are the results.

| | m. | s. |
|---|---|---|
| Longitude of landing place on Breakwater by four chronometers | 16 | 33·60 west, |
| Longitude of staff on Mount Wise by Trigonometrical survey | 16 | 38·1 |
| By mean of four chronometers | 16 | 39 8 |
| Difference | | 1·7 |

Mr. Dent also reported respecting his Steel Balance Spring, coated with pure gold by the electro-metallurgic process; also of the performance of his clock, in which the impulse is given to the pendulum at or near the centre of percussion. By this contrivance he proposed to obviate the difficulty occasioned by the oil freezing at low temperatures. The stopping of clocks at very low temperatures had induced the Astronomer Royal to invent a *new* escapement, which seemed to answer all the conditions required; an addition of twelve pounds could be added on to the weight of the clock, and yet a variation was produced in the arc of vibration amounting to *only* five minutes, while an addition of one pound to the weight of the ordinary Graham's escapement, made a difference of fifteen minutes; by Mr. Airey's plan there was always, (if the term might be used,) an extra reservoir of force; keeping the train of wheels always up to their work, and capable of overcoming the resistance occasioned by the freezing of the oil. Mr. Dent then explained the principle of his patent Compensation-balance.

*Mr. Frodsham* made some remarks on the compensation balance of chronometers, and explained a new compensation balance of his invention.—*Sir Thomas Brisbane* said, that praise was due to Mr. Dent, as the first maker who had exerted himself to determine the difference of meridians by chronometers. He had shown, that by chronometers the difference of longitude could be had with as much certainty as by any other method in use, and at an expense bearing no proportion to that of rockets, or any other means hitherto adopted. Dr. Robinson, of Armagh, was at present engaged in a series of rocket observations in Ireland. It had been the intention of Dr. Robinson to connect the Irish with the Scotch observatories, and for that purpose a large depot of rockets had been obtained from government, and stood in Dumbarton Castle; but unfortunately the unfavourable weather in spring had prevented the execution of the design, and he had received a letter, within a few

days, from Dr. Robinson, stating that the strong twilights of the present season would make it requisite to postpone the work until autumn; these facts would at once convince the Section of the superior economy and saving of time to be attained by adopting Mr. Dent's suggestion of chronometrical observations.—*Mr. Holden* enquired, why the method of moon-culminating stars, which was so simple and easy of application, was not preferred to any other in determining longitudes?—*Sir Thomas Brisbane* replied, that to say nothing of the heavier amount of labour required in such observations, he need only, in order to show the superiority of Mr. Dent's method, state the fact, that in a late attempt to connect the Royal Observatories of London and Paris, backed by all the instrumental accuracy and unrivalled skill of the observers at these two distinguished observatories, 300 observations on moon-culminating stars had given a mean deviating no less than thirty seconds from the truth.—*The President* (Rev. Dr. Peacock, Dean of Ely) observed, that although the method of moon-culminating stars had, in theory, promised considerable accuracy in the determinations of longitudes, yet from some unexplained difficulties it had, in practice, fallen far below the estimate that had been formed of it.—*Athenæum.*

ASTRONOMICAL CLOCKS.

Professor *Bessel*, of Königsberg, made a communication on an astronomical clock. Having ever been of opinion, that that indispensable instrument to the astronomer, a transit clock, could only acquire perfection if the pendulum—separate from the whole of the works—were made to vibrate in equal time, whatever the temperature and the arc might be, he would suggest some hints on this subject. After noticing Mr. Frodsham's ingenious contrivance of an isochronal piece, to compensate for the variation of the arc, he said, supposing that contrivance had been successful, there would be no more any difficulty in making the rate of the pendulum independent, as well of the vibration of the arc, as of the heat. He would submit, whether the expeditious method of coincidences might not be employed for checking the pendulum in both respects. The pendulum, apart from the clock, being suspended from the wall, a clock, taken out of its case, might be placed before it at a distance of 6 or 8 feet; an object glass of 3 or 4 feet focal length, might be placed between both, so as to produce, exactly at the lower end of the pendulum of the clock an image of the lower end of the other pendulum. Then the coincidences of both might be accurately observed, by a telescope placed at a convenient position for seeing both. Similar contrivances had been described in an account of some pendulum experiments made at Königsberg; and the accuracy of the method was such, that the relative rate of both pendulums might be ascertained with sufficient accuracy in a very short time—in from 10 to 20 minutes. The rate of the pendulum was to be tried at different temperatures, being placed in an open box, covered at the lower end with glass, and so fastened to the wall that the pendulum could swing within it. Two metal tubes should be passed through the box, and might be heated with water or steel, so as to heat the air in the box. Previously to heating it, the air should be deprived of its moisture; and two or three thermometers placed in different situations in the box, showed that the heat was pretty uniform. Then, if the pendulum were swung both before and after heating, it would be easy to ascertain the rate, and compensate for the heat. He believed that not only the readiness with which both these experiments might be made, but also the perfect isolation of the pendulum, would recommend this method to artists and astronomers; and he had been desirous to try it himself, but had been prevented by delay in the construction of a pendulum provided with Mr. Frodsham's isochronal piece. In the construction of the pendulum, attention should be paid to one thing which seemed to have been much overlooked. It often happened that chronometers affixed to the top and bottom of a clock case, when it was evident that the compensation was acting only below, would not compensate for the variation of the whole. He should prefer, for this purpose, the gridiron to the other form of pendulum, especially if we began as low as possible below the point of suspension, and endeavoured to carry it on to the centre of gravity. He should prefer the several rods to be of equal diameter, and to act uniformly. Perhaps the application of galvanism, which Mr. Dent had so beautifully applied to coating spring pendulums with gold, would best answer the purpose. Supposing the spring perfectly regulated, as well with respect to the heat as the arc, only one cause would interfere with regular vibrating times. This was the effect of that quality of the air which depends on the variations of the height of the barometer; and the other part would depend upon the variations of the thermometer, and the adjustment of the compensation for heat. There was a possibility of compensating the former by fastening a barometer tube to the pendulum, and it would not be difficult to find the suitable diameter of the tube; but he was aware,

that this complication of the pendulum would be rather inconvenient. At all events, the variations of the barometer were not very great, especially if the compensation of the pendulum be made as great as possible. He submitted these hints to those celebrated artists, whose admired works had very greatly contributed to the promotion of astronomical purposes, and the determination of the longitude.

A discussion took place, in which Sir Thomas Brisbane, Mr. Dent, Mr. P. Clare, and Professor Stevelly took part, and which, having departed from the points of Professor Bessel's paper, was properly checked by Sir John Herschell, who said, the question was, whether the arc of vibration was or was not completely nullified. By Professor Bessel's plan of compensation, that was brought within a short period of fifteen or twenty minutes, which, according to the ancient modes of determination, would have taken a whole day.

[*The Chairman*, in proposing the thanks of the section to Professor Bessel, spoke of him as an illustrious astronomer, whose whole life had been devoted to the advancement of astronomical science, and who possessed in a remarkable degree the most profound knowlege of the principles on which every instrument submitted to his care was constructed, combined with the highest application of physical astronomy.—*Sir Wm. Hamilton* would repeat what he had said, in a former year, of Professor Bessel, who, for the consummate union of theory and practice, must be placed in the very foremost rank, and might be placed perhaps at the very head of the astronomers now living.]

### MAGNETS.

The *Rev. Dr. Scoresby* made a communication "On improved permanent magnets, and the mode of determining their powers, with certain undescribed phenomena in permanent magnets." In the cases of powerful compound magnets, where large masses of steel were required, the absolute conditions were, that these masses should be of the best possible quality of [Swedish] steel, of the denomination of cast steel (and not shear or blister); and that they should be hardened to the greatest possible degree of hardness. For want of attention to these conditions, he frequently found magnets of bundles of eight or ten steel bars, when even two bars would have a stronger power. The Rev. doctor illustrated these matters by copious explanations, diagrams, and experiments with a powerful compound magnet, consisting of two bundles of steel bars or plates in a wooden frame, which took up about 11,000 nails (tin-tacks); which, when in suspension, were capable of being moulded in the most curious manner. Holding a key (weighing 3,000 grains) at four inches from the ends of the magnets, this key became temporarily so powerful a magnet as to take up and suspend another key, weighing between 2 and 3,000 gr. Dr. Scorseby showed, that, by drawing a piece of steel down the back of his hand in one direction, the palm of his hand being pressed against his powerful magnet, he could give the steel a considerable magnetic power through his hand, and by reversing the direction of the steel, he could as easily demagnetize it. Of nine sea compasses, sent to him from her majesty's stores, the material of one was not better than the steel for coach springs; hence it would only lift 600 grains, while his own, of the same weight, would raise 3,309 grains. He had ascertained the means of testing magnets with such accuracy, that it would be as absurd to have a bad compass in future as a bad sovereign.

### ACTION OF AIR AND WATER UPON IRON.

*Mr. Mallet* read a paper on the action of air and water on iron. This is the third report for which the Association is indebted to Mr. Mallet. The object of former tabulated results was to determine the actual loss by corrosion in a given time, and the comparative durabilities of rust of the principal kinds of cast-iron of Great Britain, and to discover on what durability depended. The tables of experiments now presented show, that the rate of corrosion is a decreasing one in most cases; and that the rapidity of the corrosion in cast-iron is not so much dependent upon the chemical constitution of the metal as upon its state of crystalline arrangement, and the condition of its constituent carbon. The present report, too, extends the inquiry to wrought-iron and steel, of which between thirty and forty varieties have been submitted to experiment. The results show, that the rate of corrosion of wrought-iron is in general much more rapid than that of cast-iron or of steel. The finer the wrought-iron is, and the more perfectly uniform in texture, the slower and more uniform is its corrosion. Steel corrodes in general more slowly, and much more uniformly, than wrought or cast-iron. The results of the action of air and water in the several classes of iron have been examined and chemically determined. The substance spoken of as plumbago was next described. It is produced by the action of air and water on cast-steel, especially that in the raw ingot, in the same way as it is in the case of cast-iron. A quantity of plumbago, found in the wreck of the *Royal George*, absorbed oxygen on exposure to the air with such rapidity,

that it became nearly red-hot. Mr. Mallet next described a method of protecting iron by a modification of the zink process. It was found impossible to cover the surface of iron with zink, to which it had no affinity. The first process was to clean the surface of the iron, taking off the coat of oxide, and then immersing it in double chloride of zink and ammonium, which covered it with a thin film of hydrogen, by which its affinity for the zink is much increased. The iron was then covered with a triple alloy of zink, sodium, and mercury. Mr. Mallet produced several specimens of his alloy, one of a bolt to be driven into a ship's side, and another a cannon shot covered with his preparation, and exposed to the weather on the roof of a building, and which was perfectly preserved. Cannon balls were so much oxidised by exposure to atmospheric influences, that in five or six years they become useless. The French Institute had been engaged in experiments to protect these, and had tried zink, but had been compelled to abandon it. Mr. Mallet also brought under the notice of the section a method of preventing the fouling which takes place on the bottoms of iron ships, especially in tropical climates, by means of which new invention he had ascertained plants and animals were prevented from adhering to the ship's bottom. Another series of experiments related to the rate of corrosion of cast-iron, wrought-iron, and steel, exposed to atmospheric influences—a matter of great importance to the engineer. The characteristic form of corrosion in air, as contra-distinguished from that of water, was also pointed out. This series of inquiries was now complete. The next matter which had engaged his attention was the rate of corrosion of rails on railways. The general opinion was, that the rails travelled over were not corroded at all. He had been enabled to lay down three sets of rails on the Dublin and Kingstown Railway; one not travelled over, the second in use, and not exposed to corrosion, and the third also in use, but made impervious to moisture. The loss of the first was 2555, of the second 5314, and of the third 2650—results which seemed to indicate, that the rail travelled over does corrode more slowly than that out of use.

### COMBUSTION OF COAL AND PREVENTION OF SMOKE.

*Mr. Fairbairn* read the report of a committee appointed at the meeting held at Glasgow, in 1840, (in consequence of a paper read by Mr. C. W. Williams,) to make experiments upon the combustion of coal and other fuels, with a view of obtaining the greatest calorific effect, and avoiding the generation of smoke. The report stated, that very great ignorance existed on the subject of combustion, and a most extravagant waste of fuel was committed in most of the districts in which steam power is extensively used. In Cornwall, where necessity had compelled the introduction of great economy in the management of steam-engines, a system of slow and complete combustion was practised which unfortunately, could not be generally adopted in Lancashire, where most of the proprietors of steam-engines had subjected themselves to serious evils by a want of capacity in their boilers, and a system of overworking, in every way opposed to perfect combustion, and attended with consequences equally objectionable, whether as regarded the public nuisance of smoke, or the increased expenditure of fuel. In many establishments, engines were loaded to almost double their nominal power; requiring steam far beyond the just capability of their boilers, and to be obtained only by forcing their fires, and too frequently dispersing through the atmosphere a quantity of valuable fuel, which, under other circumstances, might be usefully and beneficially employed. These were evils which could be abated only by the zealous concurrence of proprietors of steam-engines themselves; but it was to be hoped that a few striking examples of great economy and perfect combustion would have considerable effect in directing the attention of these parties to a due consideration of their own interest and of the public welfare. The report then went into a minute description of the relative proportions of furnaces, boilers, flues, and chimneys, in this and other districts, from which we select the following points. In Manchester, the usual proportion of the area of the fire-bars to the heating surface of the boiler is about one to eleven, or 100 square inches to eight square feet of flue per horse-power. In a well proportioned boiler on the plan usually adopted in this district, a pound of moderately good coal will evaporate about 7·46lb. of water, being nearly the *maximum* duty effected here. A number of experiments had been made upon engines in this town, the results of which were given in a table exhibited to the meeting, specifying the nominal power of each engine, the power at which it is worked, the proportion of heating surface to the grate-bars, the height of the chimney, the consumption of fuel per horse-power, &c. The greatest consumption of coal (13lbs. per horse-power per hour,) was in an engine of 45 horse nominal power, worked up to 76 horse, and having the grate-bars in the proportion of 10·87 of the heating surface of the boilers. The smallest consumption (8·8lbs. per hour) was in an 80 horse-engine worked to 110 horse, and having its grate-bars

in the proportion to the flues of 1 to 12·70. The second in point of economy, however (9·1lbs. per hour,) had the smallest proportion of heating surface of the whole number experimented upon. The general average of the consumption of coal was 10·53lbs. per horse-power per hour. That this was far beyond what it ought to be, was exhibited by the fact, that the average consumption in the best Cornish engines was only 2½ per hour —something less than one fourth of the amount in this neighbourhood. The report proceeded to detail the results of some experiments on the comparative consumption of coals in a furnace to which Mr. Williams's apparatus for the consumption of smoke had been applied, when that apparatus was at work, and when it was thrown out of use. Some of these experiments appeared to be vitiated by the want of a perfect closing of the air passages when that apparatus was not used. Further experiments were consequently tried with the air passages open at one time, and at another closed by a brick wall. The result was, that the average consumption with the apparatus at work was 276 lbs. per hour, and with the air passages effectually closed, 308¾lbs. per hour, showing a difference of 32½lbs. per hour in favour of Williams's plan, or a saving of rather more than 10 per cent. The report stated, in conclusion, that there could not be the slightest doubt about the practicability of abating the nuisance of smoke so much complained of in many districts.

*Mr. Henry Houldsworth* said, that for six months past, he had had practical experience of the working of Mr. Williams's patent, which he had applied to six different furnaces; and he could now say confidently, from the results of that experience, that without any particular trouble or care of management, it would prevent, at the very least, three-fourths of the smoke which was now made. He did not doubt that other inventions might be equally effectual when they were carefully managed; but he preferred Mr. Williams's, because of its extreme simplicity, depending as it did solely on the admission of air in a proper manner, without any of those mechanical contrivances, worked by some moving power, which many other plans contained. There was one fact connected with Mr. Williams's patent, which he considered of some importance, which he would communicate to the section. He had that morning fitted up a contrivance for ascertaining the comparative temperature of flues under different circumstances, which had not previously been very satisfactorily ascertained. Mr. Williams had used a thermometer, inserted in a bar of iron, which was placed in a flue; but he (Mr. Houldsworth) was not satisfied with that plan, and had passed a copper wire through the flue from one end to the other. This was kept in a state of tension by a weight, and by its expansion or contraction, acted upon an index, which would give a very correct measure of the relative temperature. He had tried some experiments with it that morning, and had obtained very striking and important results. It had generally been supposed, that, when there was a perfected red fire in the furnace, and when no smoke was generated, the admission of cold air at the bridge would do harm instead of good, by reducing the temperature in the flues. He had, however, tried the experiment that morning. After having the air passages closed for some time, he had opened them when the coals on the fire were perfectly charred, and found an immediate and decided increase of temperature in the flue. The increase of temperature was certainly most striking, if the air passages were opened shortly after a large quantity of fresh fuel had been put on; but at all times he found there was an increase when the air was admitted, and a decrease when it was excluded.—In answer to a question from Mr. E. Corbett, Mr. Houldsworth stated, that in one experiment, about three cwt. of coals were thrown upon the fire at once, so as to produce a thick black smoke; when the air passages were closed, that smoke was immediately dissipated by opening them, and the temperature rose rapidly. On closing them again, the smoke returned, and the temperature as rapidly declined.—*Mr. Taylor* (the treasurer of the Association) said, the subject before the section was undoubtedly of great importance to the manufacturers of this district; for they had already heard from Mr. Fairbairn, that, whilst the average consumption of ten engines in Manchester was 10½lb. of coal per horse-power per hour, the average consumption in the Cornish engines was only 2½ lbs., so that they did as much work with one pound of coal as a Manchester manufacturer did with four pounds; and, at the same time, they made very little smoke. In the parish of Gwennap, with which he was connected, there were twenty-five engines, all of very large power, from the chimneys of which very little smoke indeed would be seen. He did not know that they adopted any contrivance for the prevention of smoke, beyond that of admitting air at the bridge; but they gave plenty of furnace room and plenty of boiler room, and made a rule of keeping bright their fires, and of coking all their coal in the front of the furnace. The great source of their superiority was, however, in his opinion, to be found in the fact, that as the engines were all employed in pumping water,

it was exceedingly easy to ascertain the amount of work which each engine performed with a given quantity of coal. This was invariably recorded and published, and it produced great emulation amongst the engine-makers, the proprietors, and the workmen, each of whom was ashamed of being outdone by his neighbours; and from their joint care and exertions, and more especially from those of the workmen employed, resulted that extraordinary economy, of which the Section had just heard.—*Mr. Richard Roberts* said he quite agreed with Mr. Taylor, that with due care on the part of the fireman, a sufficient area of grate, and sufficient boiler room, smoke might be effectually prevented, without resorting to any particular contrivances.—After some further discussion, in which Mr. Edmund Ashworth, Mr. Webbe Hall, Mr. Joshua Milne, and other gentlemen took part, *Mr. Jeremiah Garnett* said, he could not permit the discussion to close without directing attention to one fact—viz., that, although they had had a variety of opinions about the best mode of preventing smoke, no one amongst the many scientific men and manufacturers present intimated the slightest doubt that smoke might be prevented, and that the nuisance if not entirely removed, might be exceedingly diminished. If, therefore, parties working steam-engines would neither consult their own interests, nor consider the public welfare, he trusted the legislature would interfere to compel them. There was one point adverted to by Mr. Taylor and Mr. Roberts, on which he would say a few words, as it might do harm out of doors. They had mentioned an abundance of grate and boiler room, as a means of preventing the nuisance of smoke; and no doubt it was so. But there was a danger that parties who were deficient in those respects might plead that deficiency as an excuse for continuing the nuisance. It was, therefore, necessary to remind the Section, that, though desirable, an abundance of grate and boiler room was not necessary to the prevention of smoke. He knew from Mr. Houldsworth, that the very successful experiments made by him were made upon engines which were limited in those repects. What had been done by Mr. Houldsworth could be done by any other parties; and, therefore, those who continued to poison their neighbours with smoke were without excuse.

At a subsequent meeting of the Association, *Mr. Houldsworth* said, that since the previous discussion on this subject, he had made some careful experiments with the pyrometer which he then described; and the results were, in his judgment, exceedingly satisfactory and conclusive. These experiments were made upon a furnace fitted up according to Mr. Williams's patent, by putting three cwt. of coal upon the fire two different times, the fire being each time in the same state, and the temperature of the flue, as indicated by the pyrometer, being in each case about 700 degrees. On one occasion, the air-passages were left open, in the other they were closed; in each case the experiment was continued for 100 minutes. In the experiment in which the passages were left open, the average temperature of the flue was about 1,100 degrees; in that in which the passages were closed, and Mr. Williams's apparatus thrown out of use, the temperature averaged only about 900 degrees. During the whole time of the former experiment, there was an entire absence of smoke; during great part of the latter, the flues were filled with smoke. Mr. Houldsworth exhibited a diagram, showing, in a very striking manner, the results of his experiments.*—*Mr. Fairbairn* said, there could be no doubt whatever, that smoke might be most effectually prevented, and therefore the public ought no longer to be subjected to so grievous a nuisance.

### THE ATMOSPHERIC RAILWAY.

*Professor Vignoles* introduced a long and elaborate communication on this subject by the following observations.

"The general interest of late attached to the generation of motion on railways by means of the pressure of the atmosphere, and the fact that, for the last two years, experiments of this sort have been publicly exhibited in the neighbourhood of London, must be the excuse for my presuming to present myself before the British Association, and attempting to be the humble expositor of the very ingenious and remarkable invention which is so characteristic of the present age. The allegations of the parties who have brought it forward, particularly of the inventor himself, to whom I shall presently take the liberty of calling your attention as a townsman of Manchester, are well worthy of consideration; more especially as the subject is exciting that degree of interest, that certain parties are about, and have recently begun, to adopt it on one of the railways of the United Kingdom; and the government have thought fit to depute some of the official parties to make a special report on the subject. Sir Mark Brunel has said, with very great propriety, that it was much easier to describe an operation when finished, than when in the course of preparation. I claim, therefore, your indulgence, if, in this respect, I have to describe an operation, which, if

* This diagram we hope to be able to give in our next No.—ED. M. M.

not quite in its infancy, at all events has not met that degree of public attention which it so eminently deserves. I consider that the time has now arrived when it is quite proper that this principle of producing motion should be put before the public in a familiar manner; and I am happy and proud in having been selected as the instrument to bring it thus before the public, for the first time, in an official manner. The object of this discourse is to invite discussion,—to court inquiry,—to elucidate truth. When we consider the enormous expense which we have incurred in the construction of the principal lines of railway, and the still greater proportionate expense in working them out, it is not singular that all the efforts of ingenious men should be directed to the ascertaining, amid the numerous secrets which nature still holds, some means of producing motion upon more economical principles. I will take the liberty of making a quotation from one of the most eminent railway individuals in this country—from one who has done more towards advancing the improvements of railway conveyances than any other man,—Mr. Henry Booth, the talented manager of the Liverpool and Manchester Railway. He says, that in all countries, and under all circumstances, 'it is an object worthy of the statesman and the philosopher to give a right direction to public expenditure, and to prevent the reckless waste of the national resources.'"

The learned Professor proceeded to give an historical sketch of the various plans which had at different times been proposed for obtaining mechanical power from the pressure of the atmosphere—by Papin, Lewis, Medhurst, Vallance, Pinkus, and lastly, Mr. Clegg, the inventor of the system which has, during the last two years, been exhibited in successful operation at Wormwood Scrubbs. Mr. Vignoles then described Mr. Clegg's plan very fully and minutely, and with great ability and clearness, but as we have already given a sufficiently ample account of it in our pages (see *Mech. Mag.* vol. xxxiii. p. 86) we shall pass on to the general conclusion at which the Professor arrived. Having alluded to the discussions that had taken place respecting the relative advantages of locomotive and stationary power, when the Liverpool and Manchester Railway was constructed, Mr. Vignoles pointed out the waste of power arising from friction, atmospheric resistance, and other causes, and then drew attention to a table giving a comparative analysis of the power of Mr. Clegg's air-pipe under various circumstances. The result was, that, with a pipe six inches in diameter, and an air-pump 21 inches in diameter, he could, *having deducted all resistances, drive a carriage laden with 45 tons, with a uniform velocity of 30 miles an hour.* Mr. Vignoles also exhibited and explained to the meeting a diagram representing the various degrees of pressure in various inclinations, and remarked, that the general adoption of the atmospheric railway would be a great public convenience, there being no necessity for stopping from one end of the line to the other, and the saving that would be effected being very considerable. He also observed that railways already constructed might, with a very trifling expense, be adapted to the pneumatic principle. A commission had been appointed for the purpose of investigating the proposed plan; and, although they had not reported in a very decided manner, still they pronounced opinions respecting the system which were quite conclusive as to its practicability. The directors of the Dublin and Kingstown Railway had obtained a government grant for the purpose of extending their line two miles further. The extension of this line was to be constructed by Mr. V., and the locomotive power was to be on the atmospheric principle.

### LOCOMOTIVE AXLES.

*Professor Vignoles* made a communication on Straight Axles for Locomotives. He stated that an unfounded prejudice existed in favour of cranked axles, which, in his opinion, were inferior to straight ones in almost every point of view. With straight axles, the cranks were thrown outside the wheels, which gave more room for the arrangement of the working parts; and another great advantage was gained by lowering the boiler nearly fifteen inches, and thereby increasing the safety of the engine, by placing the centre of gravity nearer the rail. The original expense of the engine and of the repairs was also much lessened. These advantages might be shown by a reference to the Dublin and Kingstown Railway. By introducing straight axles and outside cranks the expenses had been greatly decreased; no accident had ever occurred from breakage; and such increase of room had been obtained, that they had placed the tender underneath the engine, thus fixing the centre of gravity as low as possible, and dispensing with the separate tender. By this arrangement they could run fifteen miles without stopping for water. Many accidents had taken place in consequence of the breaking of cranked axles; and Mr. François and Col. Aubert, in their report to the French government, had remarked that the fractures of broken axles, instead of the fibrous appearance of wrought iron, presented the crystallized appearance of cast iron, which they attributed to magnetic

or electric changes in the molecular structure of the iron, caused by friction in the bearings and great velocities; and in his opinion it was probable that the continual strains and percussions to which the crank axle is subjected would account for the changes in the molecular constitution of the iron.

*Mr. Hodgkinson* was certain, from the results of his experiments, that a succession of strains, however slight, would produce a permanent deterioration of the elasticity of the iron.—*Mr. Fairbairn* had been told by the engineer on the Leeds line, that he considered all crank axles to be constantly deteriorating from percussions, strains, &c., and that they should be removed and replaced by new ones periodically, to avoid danger of fracture.—A discussion arose as to whether the crystallized appearance observed in fractured axles arose from defects in the manufacture, in the quality of the iron, or from the effects of working, either by percussions, strains, or magnetic action.—*Mr. Grantham*, although a manufacturer of cranked axles, admitted that straight axles were less liable to break. Cranked axles, from the way in which they were welded together and shaped, were rendered weak and liable to fracture. On other grounds, however, he believed that the cranked axles were preferable, as they produced a steadier motion, and much heat was saved.—*Mr. Garnett* believed that more straight axles had broken than cranked ones. —*Professor Willis* showed the effect of vibration in destroying molecular arrangement, by reference to the tongues in musical boxes, &c.—*Mr. Nasmyth* believed that the defects in axles, &c. arose in the manufacture, especially from cold swaging and hammering, and also from over-heating in welding, all of which causes injured the toughness of the iron. In small articles, he found great advantage from annealing; and he believed that axles might be annealed very cheaply, and would be more serviceable. He disliked the fashion of referring all unaccounted phenomena to magnetism and electricity, although he was convinced that very singular electric phenomena accompanied the transit of locomotives and the rapid generation of steam. With this was connected the non-oxydization of rails, where the traffic was in one direction, and the rapid oxydization when the same rails were travelled over in both directions, as in the Blackwall railway. He had also observed that brasses, in some cases, had from friction entered into *cold fusion*,—that is, at a heat not perceptible to the eye, a complete disintegration of the molecular structure had taken place, and he had seen the brass spread as if it had been butter or pitch. He had no doubt that this arose from electricity, but had not ascertained the fact from experiment.—*Mr. Fairbairn* stated, that in hand-hammered rivets the heads frequently dropped off, and presented a crystallized appearance, while those compressed by machine were sound. He found that repeated percussions, from the rivetting, hammering plates, &c., induced magnetism in iron boats.—*Mr. Vignoles* could not, from his experience, subscribe to Mr. Nasmyth's theory of the oxydization of rails by single traffic, as the railway from Newton to Wigan had been single for a long time, and was as bright as the Manchester and Liverpool. The Blackwall railway was not an analogous case, as no locomotives were employed.—*Mr. Roberts* disbelieved the deterioration of axles by work; he would rather trust an old axle than a new one. He believed cold swaging and hammering to be the chief causes of mischief. In fact, if axles were sent out sound and well manufactured, they would rather improve by working.—*Athenæum.*

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## INSTITUTION OF CIVIL ENGINEERS.
### MARCH 22, 1842.

"*Results of a Trial of the Constant Indicator upon the Cornish Engine at the East London Water-works.*" *By Professor Moseley, F.R S., &c.*

The object of this communication is to exhibit and explain the results given by the author's indicator during a continuous registration from the 28th January to the 25th February 1842, the engine during that time making 232,617 strokes. The numbers registered by the counter of the engine and the indicator were noted each morning and evening, and are recorded in a table appended to the paper. The differences between each two consecutive numbers registered by the counter, giving the number of strokes made between each two observations, are contained in one column of the table, and in another column are the differences between the successive registrations of the indicator. These are followed by the mean registrations of the indicator at every stroke of the engine, being the quotients of the numbers in the last-named column divided by the corresponding numbers of the preceding column. The paper after thus stating the numbers registered daily by the indicator during the period of trial, proceeds to explain the formula to which they are to be applied, in order to determine the work done daily by the engine. The formula, when reduced from the general one by the introduction of the numerical values of the constants dependant upon this engine, is

$$U = 161{\cdot}4474\, N - {\cdot}09051\, L.$$

In this expression, U represents the units

of work (in lbs. raised one foot high), done upon each square inch of the piston through any given time, during which the number registered by the indicator is represented by N, and the space in feet which the piston traverses by L. The second term of the formula, which is very small as compared with the first, is a correction for the influence of the friction of the indicator on the number registered by it. The formulæ being then reduced by the substitution in it of the numerical values before alluded to, the whole number of units of work per square inch of the piston done between the 28th January and the 25th February is shown to have been 21·464 067·1727. From this is deduced the work done during the same time upon the whole area of the piston as well as the duty done upon the piston for each cwt. of coals. These calculations are followed by a comparison of the results given by the indicator with those previously obtained from actual experiment by Mr. Wicksteed; whence it appears, that with a necessary allowance for a difference in the lengths of stroke at the periods of the two experiments, the results of the two are almost coincident. The work per stroke upon every square inch of the piston, as obtained by experiment, is 120·574, whilst as shown by the indicator it is 119·338 lbs.

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Professor Moseley exhibited the indicator and described its construction and action; it consists of two cylinders, each four inches long, communicating by pipes with the top and bottom of the cylinder of the steam-engine to which the instrument is applied. In each of these cylinders there works a solid piston four square inches in area; both being fixed upon the extremities of the same rod, which (when the indicator is in action) sustains in the direction of its length a pressure equal to the difference between the pressures upon the two indicator pistons, or equal to the effective pressure of the steam on four square inches of the piston of the engine. This pressure is made to bear upon a steel spring, connected by a link at each end with a similar spring, supported at its centre upon a projection from the frame of the instrument. The pressure of the piston-rod upon the lower spring, causes the two springs to separate from each other, and the separation produced is, by a well-known law of deflection, directly proportional to the pressure sustained, so long as the deflections are small. A peculiar form, first suggested (it is believed) by M. Morin, is given to these springs; one surface of the spring is plane, and the opposite surface is of a parabolic form, by which equal strength is given throughout every portion of its length. In a spring thus formed, the deflection is distributed more equally throughout, and being thus diminished for a given separation of the springs at every point, the elastic limits are nowhere so soon exceeded.

By this connexion of the piston-rod with the springs, its position is made to vary directly as the effective pressure upon four square inches of the area of the piston of the steam-engine, so that every additional pound in that pressure will cause the piston-rod to alter its position by the same additional distance in the direction of its length.

A steel wheel (termed the *integrating* wheel) having the edge milled, turns upon the piston-rod as its axis, traversing with it also in the direction of its length. Through the arms of this wheel pass three rods, connected at their extremities by two pieces so as to form with them a rigid frame, which turns, in fixed bearings, upon hollow axes through which the piston-rod passes, so that the integrating wheel is free to traverse longitudinally upon the frame, but cannot revolve without carrying the frame with it. The integrating wheel is made to revolve by the rotation of a cone which is held in contact with it by a spiral spring, acting constantly against the extremity of the axis of the cone. A system of bevil-wheels communicates to this cone the rotation of a pulley, which is driven by a cord carrying a weight at one extremity and communicating by the other with the piston-rod of the engine, or with some point whose motion accords with it, but travelling through a less space. The circumference of the pulley moving precisely as the piston, the angle described by the cone in any period of time, must be exactly in proportion to the space described by the piston in that time. The circumference of the integrating wheel moving with that part of the cone, with which it is in contact, the portion of a revolution which it is made to describe in a given time, is dependent, first, upon the angle which the cone describes about its axis, during that time; and secondly, upon the distance of its point of contact from the apex of the cone at that time. If either of these two elements of variation remained always the same, then the portion of a revolution, made by the wheel, would vary directly as the other, whence it follows, by a well-known principle of variation, that when both these elements vary, it varies as their product; or that the portion of a revolution, made by the integrating wheel in a given time, varies directly as the product of two factors, one of which is the angle described during that time by the cone, and the other the distance of the point of contact of the wheel and cone, from the apex of the cone. The former of these factors

varies directly as the space described by the piston of the engine, and the latter as the effective pressure then exerted by the steam upon the piston: therefore the portion of a revolution made by the integrating wheel, varies as the product of the space described by the piston of the engine during a given time, by the effective pressure of the steam upon it during that time; that is, it varies as the work or dynamic effect of the steam upon the piston during that time; whence it follows, that the number of revolutions or parts of a revolution made by the integrating wheel, during the stroke is proportional to the whole work, or dynamical effect of the steam upon the piston during the stroke.

By a number of toothed wheels the number of revolutions of the integrating wheel is registered to five places of integers, and to one place of decimals. The number registered is not diminished by the backward motion of the cone during each return stroke, because the integrating wheel ascends to the apex of the cone, and remains there during each return stroke, so that no number is registered during that interval.

In order effectually to guard, however, against any error which might arise from this reversed motion of the piston, a combination of wheels has been introduced, by which the revolution of the cone can be arrested during the return-stroke; and to adapt the instrument to register (if required) every stroke, a fourway cock has been constructed, by which one of the indicator cylinders may be made to communicate always with the steam end of the steam-engine cylinder, and the other to be acted upon by the vacuum end: in this case the movement of the cone should be constantly forwards.

The Professor then gave the mathematical formula by which the work is determined from the numbers registered by the indicator. He then described the difference between the instrument, and that of M. Morin for applying the principle of M. Poncelet, to consist,

First, in all those mechanical combinations which are peculiar to the instrument in its application to the steam-engine. M. Morin's instrument having been applied to measure the traction of horses.

Secondly; in the surface of a cone being substituted for the plane surface of a circular disc; by which arrangement the rapidity of the changes of velocity due to corresponding changes in the position of the integrating wheel is diminished in the same proportion in which the sine of one-half the angle of the cone is less than unity; and the force necessary to drive the integrating wheel being diminished in the same proportion, the chance of an error arising from the slipping of the edge of the integrating wheel on the surface from which it receives the impulse is lessened in proportion.

Thirdly; in the separation of the registering apparatus from the integrating wheel; by which separation, whilst the springs are relieved from the effect of the momentum and the friction due to the weight of the registering apparatus, the latter being in a state of quiescence, the registration is legible whilst the indicator is in action.

Fourthly; in the variable appearance of the links connecting the springs together, by which variation the same series of deflexions may be obtained under different ranges of pressure.

In fact, that the indicator has nothing in common with the "compteur" of M. Morin, except the principle of Mr. Poncelet, and the springs under a modified form.

The amount of the friction of the pistons, was then examined, and the peculiar construction of their metallic packing explained: it was shown also, that instead of great difficulties arising from the friction of the integrating wheel upon the cone, or its slipping upon the surface, a very slight pressure of the spring produced sufficient adhesion to drive the registering apparatus. The Professor then explained the advantages resulting from a registration of the duty of steam-engines generally, not during the time of a few isolated experiments, as with the common indicator, but extended over any given period, and through every stroke of the engine, displaying all the changes which had occurred during that time:—with this view it had been decided that the instrument should be attached to the engines of the *Great Western* steam vessel on her next voyage to America.

He then expressed his obligation to Mr. Wicksteed for the facilities afforded him for the experiments at Old Ford, and paid a well-merited compliment to Mr. Holtzapffel for the excellent construction of the indicator.

In reply to a question from Mr. Vignoles, he stated that the instrument was not under its present form adapted to locomotive engines, but that a grant of 100*l*. had been made by the British Association for the construction of such an instrument.

Mr. Cowper, in compliance with the request of Professor Moseley, illustrated his description by setting the instrument in motion, showing that the registration depended upon the revolutions of the integrating wheel; he demonstrated the cases of motion without pressure, and pressure without motion; in the former case, the integrating wheel being stationary at the apex of the cone while revolving, does not receive

any impulse from the contact with it, and therefore does not register; in the latter case, the surface of the cone upon which the integrating wheel traverses, being at rest, does not communicate any rotative motion to it, and consequently no registration can take place; but when motion and pressure are combined, the cone revolving, and the integrating wheel travelling from the apex some distance towards its base, the exact product of the motion of the cone and the steam's pressure upon the piston would be registered by the amount of the revolution of the integrating wheel.

Mr. Wicksteed observed, that every facility had been afforded to Professor Moseley for applying his new indicator, for the purpose of ascertaining the duty performed by the Cornish engine at Old Ford, but that he had not at all interfered with the experiments, being desirous of ascertaining whether the results would correspond with his trials. That after the work of the engine had been registered while it was making about 179,000 strokes, the mean result, as stated by Professor Moseley was so nearly that arrived at by Mr. Wicksteed, that he had no doubt of the accuracy of the machine as a good indicator of the real duty performed by the engine; the difference in the result of the mean pressure of the steam, deducting the vacuum, or 0·73lb., was 0·12lb., namely, according to Mr. Wicksteed's experiments 12·94—0·73=12·21lbs., and according to Professor Moseley 12·09lbs.; this difference might arise from a variation in the mean length of stroke during the two sets of experiments—from a slight variation in the point at which the steam had been cut off—from a variation in the level of the water in the pump well, or other practical causes—the difference, however was so insignificant, that he would rely on the accuracy of Professor Moseley's indicator, and allow the possibility of a slight error in his own experiments.

Mr. Farey observed, that Professor Moseley's instrument must be influenced by variations in the length of stroke, for whenever the piston makes a long stroke, the cone and the train of registering wheels must be turned farther round, and would register a higher number than they would do in case of a shorter stroke, supposing the impelling force exerted by the steam to be always the same. If the instrument could be really made to give its results according to the actual length of all the varying strokes made during the time of observation, by truly aggregating these varying lengths into one sum, the results would be free from the usual uncertainty respecting an average length of stroke.

In the monthly reports of engines in Cornwall the performance is reckoned according to some reputed length of stroke, which had been fixed upon for each engine, when it was first reported, and it is afterwards assumed that no departure from that reputed length has taken place, when in fact such departure does often occur.

It would be very desirable to have a moving card applied to the new instrument, in order to indicate the impelling force of the steam in the cylinder, by tracing curves on paper like those by the ordinary indicators. This, it appeared, might be done with the advantage of causing the paper on which the curve is drawn to travel onwards, and bring fresh paper into its place, so as to obtain a series of distinct curves for as many succeeding strokes.

The form of the springs of Professor Moseley's instrument would be a decided improvement if substituted for the spiral spring of ordinary indicators; Mr. Farey had applied to an ordinary indicator, a mode of exhibiting at a glance, whether the engine was exerting more or less force than its ordinary appointed task; the plan answered that purpose; but as it required the indicator to be always in action the spring of the indicator broke after working more than two days, he therefore abandoned it. The springs in the new instrument were proved by the trial at Old Ford to be capable of enduring continual exertion without breaking.

The Professor had stated that the scale of flexure of the new springs was found to be exactly, according to theory, equal divisions with equal forces; this might be expected, because the flexure of the springs was small, and the bending force acted in a direction nearly at right angles to the length of the springs. In ordinary indicators the scale should not always be equal divisions, because the wire of the spring being wound spirally into a screw of small diameter, the spiral obliquity of the thread of such screw becomes more oblique to the direction of the bending force, as the spring is stretched, and less oblique as the spring is compressed, and hence the scale of pounds per square inch, by which the curve should be measured for summing up the results, ought to be a scale of unequal divisions.

The indicators originally used by Boulton and Watt were of a large size, with a long and powerful spring curled into a cylindric form, as large in diameter as could be included in the cylinder of the indicator, and the motion allowed to the piston by the spring was very short; such indicators were judiciously proportioned, and they do not show any sensible inequality of divisions in their scale. But recently, indicators have been frequently made without the knowledge

of their true principle, and the rules of proportion are not observed, so that it will sometimes be found, on actual trial of such instruments with weights, that their scale of pounds per square inch is not in equal divisions, although it is usual to employ a scale of equal divisions for summing up the curves traced by them.

In Boulton and Watt's indicators the scale of pounds per square inch was formed from actual trial with weights; but such trials were made when the indicator was cold, and dismounted from its place upon the steam-engine.

A much better mode is to apply the weights on the upper end of the piston-rod when the indicator is placed on the cylinder of the engine, while it is hot, its piston being supplied with the same quantity of oil, and the spring being in the same state as when it is in use. The depression of the piston by the weights is recorded by drawing a line with the pencil of the instrument on the card itself in the same manner as the usual atmospheric line is drawn thereon.

A series of lines thus drawn with given weights, become so many original stages for subdividing between them, to form a true scale for summing up the curve described under the same circumstances and nearly at the same time.

Professor Moseley's instrument had two cylinders and pistons operating in concert on the same piston-rod, and springs of peculiar construction, to indicate the unbalanced pressure exerted by the steam to impel the piston of the engine. The elastic force wherewith the steam acts above the piston (called the positive pressure or plenum) is shown by a common indicator, but the elastic force wherewith the uncondensed steam is at the same time reacting beneath the piston (called the negative pressure, or imperfect exhaustion or vacuum) is not shown; hence the observations are limited to two odd halves of the stroke made by the piston; those halves being commonly the plenum during the descent, and the exhaustion during the ascent of the piston; it is taken for granted that the other two odd halves are the same as those which are observed, although such assumed parity is not always the true state of the case.

In the new instrument the indication that it would make by drawing on a card, would be that of the difference subsisting between the plenum above, and the exhaustion beneath, the piston of the engine during its descent and ascent, wherefore it would indicate on one card as much as two ordinary indicators can do on two cards, if they are applied one to the top and the other to the bottom of the cylinder of the steam-engine; in that case each indicator shows on its own card what the elastic force of the steam is during the plenum, and what it is during the exhaustion, but the required result (which is the difference between the two) must be obtained by combining together in the computation those distinct curved lines which are drawn on two separate cards. Professor Moseley's combined indicator pistons, acting on the same springs, would at once indicate such difference, by the curve which it would trace on the one card.

In answer to a question from Mr. Parkes as to whether the new instrument had been put to any other test than its apparent agreement with Mr. Wicksteed's estimate of the resistance overcome, and whether the common indicator had been applied to the engine at the same time, Professor Moseley said, that he had not compared the instrument with any other, but had subjected Mr. Wicksteed's calculations to a rigid investigation, and felt quite satisfied that they approximated closely to the truth. He relied upon them as corroborations of the accuracy of the instrument.

Mr. Parkes observed that it would have been more satisfactory to engineers to have been assured that every means had been taken to demonstrate the truth of the results recorded by an instrument which had such important functions in view. He wished to know in what manner the pressures denoted had been ascertained,—whether by weights or by comparing them with a mercurial column. He had found the latter mode more exact than weights, in verifying the scale of the common indicator, as the instrument being heated was then in precisely the same state as when it was in use. He had found that a certain amount of correction was frequently necessary, as both the spring and the amount of piston friction were affected by heat.

Professor Moseley replied that the instrument had not been compared with the mercurial column, but that the resistance of the springs, and the friction of the piston and instrument generally, had been ascertained by very accurate experiments, so that he had full confidence in the results.

Mr. Parkes said that notwithstanding the respect and deference he felt for Professor Moseley's attainments and ingenuity, his past experience would not permit him to place entire confidence in the results afforded by the instrument: indeed he considered them to be altogether fallacious as representing the force acting on the piston of the Old Ford engine. He could not admit that the apparent near identity between Mr. Wicksteed's computations of resistance, and the constant indicator's registration of force

amounted to proof of the instrument's accuracy: for, it seemed to him that Mr. Wicksteed had omitted to take into account one important item of force, without the exertion of which, a piston could not be brought from a state of rest into a state of motion. He referred to the force required to give velocity to the piston. Mr. Wicksteed had weighed the greater part of that resistance which might be called ponderable, and had estimated the remainder, assigning about 12 lbs. per square inch on the piston as the total amount, after deducting the resistance to the piston's descent arising from uncondensed steam. Thus, an elastic force of 12 lbs. on the piston would counterpoise a resistance of 12 lbs., but the motion would not ensue until a superior force were applied. Considering the number of strokes made by this engine per minute, Mr. Parkes could not estimate the velocity of the piston at less than from 300 to 400 feet per minute, which was very great for this enormous mass, and would require the exertion of proportionate power. He regarded the piston of the engine loaded with 12 lbs. per square inch, as he would a ball of 12 lbs. weight in a gun balanced by a fluid of a corresponding elastic force; but such ball would remain motionless unless it were propelled by some additional force. This state of things had been denominated by Professor Barlow "the preparation for motion." Now as Mr. Wicksteed's estimate proceeded no further than the production of this state of things, and as Professor Moseley's Constant Indicator recorded the mean pressure of the steam in the cylinder as barely equal to it, he could not assent to the accuracy of either method of determining the total resistance overcome by the steam.

Mr. Parkes would cite the experience of others as to the quantity of force actually expended in giving velocity in a Cornish engine, over and above that necessary to balance the weight at the opposite end of the beam, friction, &c., included. In the fifth part of vol. iii. Trans. Inst. C. E., Mr. Enys has reported some experiments made at Mr. Parkes' suggestion, on several engines. He would cite those of the Tresavean, as the cylinder was of the same diameter as the one at Old Ford, viz., 85 inches. The water load was equivalent to 12lbs. per square inch on the steam piston, and when about half the usual velocity was given to the piston in the in-door stroke, a pressure of about 17½lbs. was denoted throughout the stroke, by a mercurial column connected with the cylinder. Mr. Loam had since transmitted to him the following abstract of experiments made on the same engine, January 28, 1842. "Two indicators were used at the same time, and an open mercurial gauge. The engine was held in-doors until the mercury became stationary, in order to ascertain the *minimum* quantity of steam power necessary to produce motion. The pressure was 15lbs. per square inch, when the water load was 12lbs."

Here, then, a force of 3lbs. was found requisite to establish an equilibrium between the power and resistance; and a further force of 2½lbs. per square inch was necessary in order to urge the mass at about the half of its ordinary velocity. Mr. Enys stated that less pressure was exhibited when the engine was brought in slower, and *vice versâ;* and this was consistent with every-day experience.

Now though the Old Ford engine had not to overcome so much frictional resistance as a deep mine engine, yet, having a weight to raise, according to Mr. Wicksteed, alone equal to 11·8lbs. per square inch on the piston, Mr. Parkes was of opinion that this could not be effected at the usual working velocity, with less than 14 or 15lbs. pressure of steam per square inch. He would suggest to Mr. Wicksteed, to repeat Messrs. Enys and Loam's experiments, and also to work his engine with steam reduced nearly to such pressure in the boiler as would barely suffice to bring the piston down. Such experiments would confirm or invalidate the results given by Professor Moseley's instrument, and probably lead to the discovery of its imperfections, should any exist.

## PURIFICATION OF THE WATER SUPPLY OF THE METROPOLIS.

SIR,—I perceive by some letters which I have lately perused in your scientific periodical, that the subject of a supply of pure water is again brought under discussion. That question has been so often brought forward, and so ably seconded by men eminent for rank and scientific knowledge, that I should not presume to address myself to you on the subject, were it not that I think it the duty of every individual to communicate his ideas, when those ideas are based on a desire to promote the comfort and health of numbers of his fellow-creatures. Many complaints of the water supplied in different houses have met my ears of late, and I really think that if Mr. Stuckey's invention can be rendered available for our great metropolis, it certainly ought to receive that attention forthwith which so excellent a plan deserves.

Much money has been expended, and

*partial* good has been obtained, but that is not enough when an evil can be remedied *effectually*. If, by means of the invention I have alluded to, the water of our noble river can be restored to its pristine purity, and delivered clear, and free from extraneous matter, to every house in London at so cheap a rate as that specified by Mr. Stuckey, it does appear to me that all the companies in London ought to adopt it immediately; and their backwardness on this occasion is only another proof of that mistaken economy which distinguishes this calculating age. They have already spent enormous sums—they expend every year costly incomes—on inefficient modes of advancing a most important object, and now they hang back, alarmed at the idea of further expense. But let them recollect that if this invention should be proved to realize all that it promises, their expenses, after the first cost would be reduced, and the object of many years of ineffectual effort gained at once.

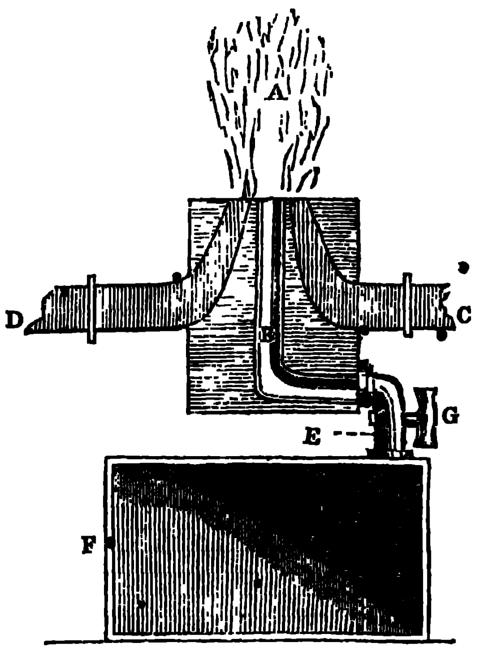
I hope the time is not far distant when the new company which is forming will supply us with water far superior in *quantity and quality*, and at *an infinitely cheaper rate*, than what we now receive from the existing monopolies.

I have the honour to be, yours, &c.,

A CONSTANT READER.

London, July 5, 1842.

## CORUSCATING BURNER.




Sir,—The above figure represents an apparatus for exhibiting a most beautiful experiment. The flame A arises from the combustion of oxygen and hydrogen, which are separately conveyed to a peculiar burner by the two conducting pipes, C and D. In this burner, which should be very thick and solid, a tubular cavity B is bored, which branches off at the bottom, and is there connected to a compression blow-pipe box F, by means of the curved tube E, and the stop-cock G.* The part B is about one quarter filled with fine filings of either iron, zink, copper, antimony, tin, silver, or their respective sulphurets. The hydrogen and oxygen gases being now let on and lighted the compression box stop-cock is turned, when a gust of expanding air, or oxygen, throws up all the metal filings through the intense compound flame, and into the atmosphere burning with vivid scintillations and of the most beautiful colours imaginable. The same thing may be done, and with, I think, some trifling advantage, by reversing the apparatus, so that the flame may play downwards, and raising it a few yards from the ground. No blowing apparatus will be here necessary, the filings being merely dropt through the tube B, which should in this case be open at both ends, the uppermost one being provided with a funnel to facilitate the introduction of the various metals.

I am, Sir, yours, &c.

M. J. BRAZENDALE.

## THE DISC PROBLEM.

SIR,—The long-pending problem of the discs having never yet been satisfactorily explained, I will, with your leave, attempt a solution, and by so doing add one more to the list of candidates for the high honour of solving this very perplexing query.†

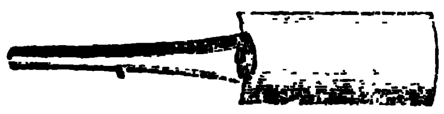
Having paid a good deal of attention to this curious phenomenon, I have tried the experiment in almost every variety of way, which has led me to the following conclusion:—*that a current of air in rapid motion, in any direction, loses the power, to a certain extent, of lateral resistance.* In proof of this, I will mention an experiment or two, and then apply it to the solution of the case in hand.

* If such a thing be not easily procured, a pair of common domestic hand-bellows answers very well.

† The phenomenon alluded to by our correspondent was first noticed by M. Clement Desormes, and was the subject of several papers in our 8th and 9th volumes. See particularly vol. IX., p. 283.—ED. M. M.

To prove, then, that air in motion loses part of its lateral resistance: Suspend a pair of scales to within a ¼ of an inch of a flat table (such as are used for weighing weights of 1 or 2 lbs., the flatter the scale-pans, the better); place an ounce weight in one scale, which will raise the other an inch from the table; then, with your mouth level with the table, and near the empty scale, blow smartly underneath it, and it will immediately preponderate with some force. The blast from a pair of bellows produces the same effect. With the breath alone, I have made the scale to descend in opposition to 4 oz. in the other scale, and have no doubt but I could raise double the weight by increasing the superficial area of the scale-pan under which the blast is directed.

On this point one more experiment will be conclusive:—Procure a piece of tin or copper tube, say ⅜ inch wide in the bore; flatten one end till it is only ⅛ thick, allowing it to expand in width as much as it will; then fasten it to one end of a common card thus,—allowing it to over-



lap the card about a ¼ of an inch, and give the card a slight curve lengthwise, so that the tube will be on the hollow side of the card; then lay another card (loose) upon this, in such position that the end of the tube is between them; then, with the tube in your mouth, hold it in a horizontal position, blow, and whether the moveable card be above or below, it will maintain its position, so long as the blast is continued. When the moveable card is undermost, small weights may be suspended from it, as in the disc experiment; the stronger the blast, the greater the weight supported; there is this difference, however, between it and the discs, that in the latter the whole force of the blast is directed against the moveable disc, operating to its disadvantage, so that it is only the *difference* of power between the two that retains it in its place, whereas, in this case, having no opposing influence to contend with, it is held in its place with a greater attractive force.

I conceive the sudden fall of the barometer during a heavy gale of wind to be analogous to this, and produced by a similar cause.

We next come to the consideration of the question, *Why* do currents of air lose part of the power of lateral resistance? To illustrate this, we will suppose air at a given pressure to be forced through a pipe of a certain width, at the rate of 2 feet per second. If any part of the pipe be enlarged to double the width, in that part it will only travel at the rate of one foot per second, its velocity bearing a constant proportion to the width of that part of the tube, when compared with the end at which it entered.

In the case of the discs, the air, after it leaves the tube, radiates in every direction, and as it increases in superficial area, the thickness of the *rings* of air, so to speak, become diminished, in proportion to their lateral expansion; otherwise the velocity of the current must be retarded, as demonstrated in the pipe experiment; hence we see the reason why the experiment succeeds best when the discs are a little concave, for by this means the capacity of the space between them is justly proportioned to the ever-varying dimensions of the current. The space is thus occupied by air in rapid motion *only*, and under such circumstances that every particle of air preserves the full amount of velocity, or momentum, imparted to it on entering the tube; consequently, any force applied to separate them, is in opposition to that momentum, because, as we have seen in the case of the pipes, an increase of volume retards the velocity of a current, so in this case, if the distance between the discs be increased, the air on leaving the tube receives a check, and is compelled to occupy a space greater, and assume a velocity less, than is due to it.

Once more: Lay the moveable disc on a table, and hold the disc with the tube within ⅛ or ¼ of an inch of it, commence blowing, and the other disc will immediately jump up, and stand, or rather hang, at the proper distance, so that the space between them shall be occupied by the current only; the air in its passage through the tube acquires a velocity that carries it forward through the increased space, till its power is exhausted; the whole of the momentum imparted to it in the tube is consumed in an effort to draw after it the air between the discs, the movable one rising to supply its place.

By giving insertion to these remarks in your highly useful publication, you

will confer an obligation on one who considers himself deeply indebted to your work for much valuable information. Perhaps it may be the means of drawing the attention of scientific men once more to this subject, for it must appear to every one an exceedingly humiliating circumstance, that an experiment apparently so simple, should remain so long in *statu quo*. I remain,

Yours, very respectfully,

WILLIAM WYNN.

Beverly, June 27, 1842.

ABSTRACTS OF SPECIFICATIONS OF ENGLISH PATENTS RECENTLY ENROLLED.

JOHN GARNETT, MERCHANT, AND JOSEPH WILLIAMS, MANUFACTURING CHEMIST, BOTH OF LIVERPOOL, *for an improved method of manufacturing salt from brine*. Enrolment Office, May 9, 1842.

Instead of applying the heat to the bottom or sides of the pans containing the brine to be evaporated, the patentees adopt the very *novel* mode of passing the heat in the form of steam through the brine, by means of pipes or tubes. "What we claim is the mode of heating brine in the manufacture of salt, by applying cylindrical or curved surface pipes or tubes for conveying steam through brine." By and by we may expect to see the heat itself laid under the embargo of a patent monopoly!

JOHN EDWARDS, OF SHOREDITCH, WAREHOUSEMAN, *for improvements in giving signals on railways*. Petty Bag Office, June 11, 1842.

Mr. Edwards, the patentee of these improvements, says, "I am aware that at stations on railways there are lamps used by which it is indicated to a coming train whether it is to stop or to proceed beyond a lamp; and (that) there are also surfaces used for like purposes for the day; but there is no means of making a communication to a coming or passing train, or between two trains." In this assumption Mr. Edwards is assuredly very much mistaken, as may be seen by reference to the specifications of Mr. Curtis, Mr. Hancock, and two or three other preceding patentees who might be named.* Mr. Edwards' "improvements" consist first as regards night signals, in using a series of lamps or surfaces "in such manner as to obtain varied communications thereby, according to the different combinations which may be made, by closing and opening the various lamps in different orders and combinations in respect to each other;" and secondly, as regards day signals, "by the use of a series of thin plates, and by the different changes which may be obtained by turning some edgewise and presenting others to view." The reader will see, at once, that there is nothing in these so called "improvements," but what is very old and also very well known. The claim is to "the mode of using a series of lamps or surfaces, and of obtaining and giving signals or communications on railways, by the varied combinations which may be had by the changing of the relations which the lamps or surfaces bear with respect to each other."

FRANCIS MARX, ESQ., OF NO. 81, EATON SQUARE, IN THE COUNTY OF MIDDLESEX, *for certain improvements in the construction of ships or other vessels, and the methods of propelling them*. Rolls Chapel Office, June 16, 1842.

These improvements consist, first, in a peculiar mode of forming the hulls of vessels; secondly, in the application thereto, or to vessels of the common construction, of submerged propelling or paddle wheels; and thirdly, in a method of connecting these submerged wheels, or any other paddle or propelling wheel, with the steam-engine and that part thereof called the waste pipe, for the purpose of facilitating the condensation of the steam.

1. "In constructing the vessel," says the patentee, "I provide a curvilinear or arched deck, which I call a shield deck, to be faced with iron, and which I form to an arch of any desirable curve, which facing shall form, with the direction of any missive discharged from cannon afloat, an angle of any desired degree, so that it may glance or throw off said missive. The said shield deck, in connexion with the hull or parts of the vessel below it, forms an air or water-tight bulk head, which may be divided into one or more compartments, and gives (by its displacement of water) a buoyancy by which said vessel will float, though said vulnerable parts of the vessel, or those parts above the line of said arch and its abutments, be pierced or torn by shot, so as to admit water. The steam-engines, machinery, and

* If Mr. Edwards had said there were no means *adopted*, he would have said no more than probably is true; for notwithstanding the number of good signal systems which have been lately invented, we have not heard of any of them coming into use. At the opening of the Primrose Hill Tunnel, on the Birmingham line, and at the Paddington Terminus of the Great Western, the system of Mr. C. B. Curtis, described in our No. 943, has been experimentally applied (at Mr. Curtis's own expense) for a great many months past, and acts so well as apparently to leave nothing to be desired; but that is all—neither Company adopts it—they see and approve, but pointing to the prodigious number of passengers conveyed without accident, seem to ask "Whether it is worth while being at a farthing of expense for the sake of the two or three ('old women or ecclesiastics') who may be occasionally smashed to piec

water-wheels, are placed below said shield deck, and every part of them below the water line, so as to be out of reach of shot; and the water-wheels being from their position submerged, are relieved from the effect of the sea."

For the better elucidation of this branch of his improvements, the patentee gives drawings of a steam-vessel adapted for harbour defence, showing the shield deck faced with iron, and supported by wooden or metal beams, or angle iron beams. The abutments of the shield deck are directed to be joined and secured all round the vessel, "in any convenient or suitable manner, and at any required distance below the water line, so as to be out of the reach of shot." The summit of the shield deck is in a line with the line of the keel and midship, and is elevated the same distance above the water line as its abutments are below it. The hatches or hatchway is placed midship in the summit of the shield deck, and fitted with water-tight metal sides, to travel or slide fore and aft on or within the shield deck. The abutments of the shield deck are in like manner below the water line, and by reason of their distance below it, out of the reach of shot; and as the surface of the shield deck is faced with iron, and may be made to present any desirable angle with the direction of any missive discharged from cannon afloat or otherwise, it is considered that "such angle will cause the said missive to be glanced or thrown off," so that that part of the vessel which is under the surface of the shield, will be effectually protected from the effect of shot.

2. The water-wheels of the vessel revolve *horizontally* under water. The wheels are hollow water-tight cylinders or drums, to which paddles or floats are attached; and are placed in wheel cases or openings made in the sides of the vessel, and fitting the wheels as near as may be without being in contact. The wheels may be either fixed permanently to or made to detach at pleasure from vertical shafts passing through the floor of the vessel into the wheel cases; and in the floor a pedestal and stuffing boxes are placed, the former to support the wheel shafts in their position, and in which they also revolve, and the latter to exclude the water. The lower ends of the shafts are in the shape of an inverted cone, and revolve on metal steps fixed in the bottom of the wheel openings or cases. The upper ends of the water-wheels are connected to the steam-engine by a crank or wheel. The middle parts of the paddle wheels are made hollow and water-tight, that they may be light and buoyant, so as to relieve their shafts from weight and friction.

3. The third improvement, which relates to the steam-engine, and by which it is stated "additional power may be obtained, and the noise commonly produced by the escapement of the steam in its passage from the cylinder is avoided or lessened," consists in making a communication by means of a pipe between, and from the escape pipe or opening of the cylinder to the centre of the upper part of the propelling wheel case encompassing the submerged paddle wheel, so that not only does the wheel case serve as a sort of exhauster to the engine, but "the centrifugal action given by the paddle-wheel to the water contained within the wheel-case, is made to condense the escaped steam."

The claim is, 1. "To the application of shield decks to vessels constructed of metal or wood, whether propelled by steam power or any other power." 2. "To the application of submerged propelling wheels upon the principle described, whether placed vertically, horizontally, or obliquely, for the purpose of propelling vessels." And 3. "The method of using the steam-engine for the propulsion of vessels, by which the submerged propelling wheel-case or apparatus is made to serve as an exhauster or exhausting medium, and the water contained within the wheel-case in which it revolves, as a condenser, thereby conferring all the advantages of a condensing engine with the lightness and simplicity of the high-pressure steam-engine, with also the noiseless action of the former."

HENRY HOUGH WATSON, OF BOLTON, IN THE COUNTY OF LANCASTER, CONSULTING CHEMIST, *for certain improvements in dressing and finishing cotton and other fibrous substances and textile and other fabrics, part or parts of which improvements are applicable to the manufacture of paper, and also to some of the processes or operations connected with printing calicoes and other goods.* Rolls Chapel Office, June 21, 1842.

These improvements, as far as regards *dressing*, consist, firstly, in the removal, by singeing off the fine protruding fibres and loose filamentous matter from the articles and goods mentioned; and secondly, in impregnating the articles and goods with a certain solution, mixture, or size, by which the articles when dried have additional body and stiffness given to them, and the fine fibres which before protruded are caused to lie down.

The improvements in the first description of dressing are carried into effect by submitting yarn, thread, and textile and other fabrics, whether comprised of cotton or any other organic fibrous substance, or of any mixture of organic fibrous substances, to the action of air, either atmospheric, or that

resulting from the ignition of combustible matter or other air, of a temperature so high as to be capable of burning or charring fine or downy organic fibres. For this purpose the patentee prefers preparing the air, by causing atmospheric or other air containing oxygen, to be blown or otherwise forced upon charcoal, coke, or other combustible matter in an ignited state. By the active combustion thus carried on a highly heated air is produced. It is found convenient to have the coke or other combustible placed in an ignited state upon and distributed along the flat iron bed of a furnace about 12 inches wide, 12 inches deep, and about 12 inches longer than the width of the cloth intended to be dressed in the middle, and from one end to the other of which bed there is an orifice about a $\frac{1}{4}$ or $\frac{1}{2}$ an inch wide; which orifice externally communicates with one end of a pipe or channel, whose other end is connected with a fan, bellows, or other apparatus capable of furnishing a continuous and regular stream of air to the furnace to keep up the combustion of the fuel when the operation of dressing is going on. The door of the furnace should be of iron, and made to fit tight when shut; the sides and ends of the furnace, except the door, may be of brick-work, but the roof or top of the furnace should be of iron or other metal capable of standing the long-continued action of a high temperature. The roof may be flat, or curved, or tapering upwards to a narrow edge (ridged) from the sides of the furnace, through the middle of the roof; and from one end to the other of it there should be an orifice from $\frac{1}{20}$ to $\frac{1}{4}$ of an inch wide, for the emission of the hot air, besides which vent there should be none other for the emission of air from the furnace. When the goods are intended to be dressed merely on the surface, it is is only requisite to cause them to pass quickly in an extended state from one roller to another (as is usual in dressing by contact with a red hot metallic plate, or the flame of combustible gas), at a short distance over and across the orifice in the roof of the furnace when a stream of the heated air is passing therefrom. The distance of goods from the orifice, and the speed at which they are passed, is regulated at the discretion of the operator, according to the rate of combustion going on in the furnace, and the force of the air blowing into and through the furnace; but when it is desired that the dressing shall be effected, both on the surface of the goods and in the interstices of their texture, a draft should be created on the upper surface of the goods and directly above the orifice from which the hot air is issuing out of the furnace by the application and use of the same apparatus, which is ordinarily used for a similar purpose when goods are being dressed, by the exposure of them to the action of the flame of combustible gas. The patentee does not claim as part of his invention the use of any of the mechanical means before mentioned, nor the use of any particular materials, but what he claims is "the application to goods intended to be dressed by singeing of air, made so hot as to be capable of burning or charring the fine fibres of organic matter, that is, causing the goods which are to be dressed and the heated air to be in contact with each other till the desired effect is produced, not confining himself to any particular mode of causing the air to be heated, nor to any particular manner of applying the air when heated."

The second improvement in dressing is stated to have "the effect according to the degree in which it is applied, of giving increased body, marketable appearance, and seemingly improved quality, to yarn, thread, cloth, and other goods, spun, woven, or otherwise prepared or manufactured from cotton or other fibrous substance, or from a mixture of two or more kinds of fibrous substances." It consists in impregnating the goods with a solution of sulphate of magnesia, sulphate of soda, or sulphate of potash, or a mixture of two or more of those salts, and then drying them. When it is intended that the dressing, stiffening, or finishing material, that is to be applied to the goods, shall possess more adhesiveness than that which would result from the use of a solution simply of the salts mentioned, the solution may have gum, mucilage, or starch, or flour size, mixed with it—the strength of the solution and the quantity of gum or other adhesive matter to be added, being regulated and varied at the discretion of the operator, and according to the effect intended to be produced. If the goods are desired to be made very stiff, the solution of the salt will be required to be a saturated one, formed at the temperature of 60° or higher; if they are not desired to be made stiff, but to have a moderate apparent increase of body given them, it will be sufficient that the solution used be of the specific gravity (temp. 60°) 1·15 or less. The solution may be applied in the same manner as that in which a flour or starch size solution or mixture is usually applied; and in such case the excess may be squeezed out by passing the goods between rollers—after which the goods may be dried in the usual manner, when they will have acquired the increased body and altered appearance. So much of this part of the patentee's invention, as regards the use of a solution of sulphate of magnesia, is applicable to the manufacture of paper. The web

leaf or sheet of paper having been formed and dried, is to be immersed in, passed through, or otherwise impregnated with the solution of salt, (the same observations relative to the strength of the solution, as above, being attended to); the excess of the solution is removed by passing the paper between rollers, or by pressing it between folds of some absorbing substance; the paper is then to be dried, after which it will have more body and stiffness than if the solution had not been applied. What the patentee claims under this head of his invention, is "merely the application of a solution of sulphate of magnesia in the manufacture of paper, and the application of a solution of sulphate of magnesia, sulphate of soda, or sulphate of potash, or of a mixture of two or more of the salts to the other descriptions of goods before mentioned or alluded to, without confining himself to any precise manner of effecting the application."

The improvements in *finishing* consist in "applying to cloth and other goods, woven or otherwise, prepared or manufactured from cotton or other fibrous substance, or from a mixture of two or more kinds of fibrous substances, a compound produced by mixing a solution of sulphate of magnesia with a solution of resin in alkali, (this alkaline combination of resin being an article much used under the name of 'Vegetable Size,' in the manufacture of paper,) or with a solution of soap, combination of tallow or other grease, and alkali." A quantity of the alkaline combination of resin ("vegetable size") or of soap being dissolved in water, a saturated or other solution of sulphate of magnesia is added thereto, by which a double decomposition takes place; the resin or grease (as the case may be) and the magnesia being precipitated together, and the sulphuric acid and the alkali forming a sulphate of the alkali. The quantity of the sulphate of magnesia to be added, depends upon the strength of the solution of resin; it being known when sufficient has been added, by a further addition not forming more precipitate: and the strength of the solution of resin to which the solution of sulphate of magnesia has to be added, depends upon the thickness of the mixture which the operator is inclined to use. The mixture may either have starch or flour size mixed with it or not, according to the discretion of the operator; and it may be used in the manner in which a mixture of flour size with china clay and other earthy matter is generally used, after which the goods may be dried in the usual manner.

A modification of this finishing process is also claimed, which consists "in first passing the cloth or goods through, or otherwise impregnating them with, a solution of sulphate of magnesia, and in afterwards passing them through, or otherwise impregnating them with, a solution of soap, or of the 'vegetable size,' or *vice versa*." The double decomposition spoken of takes place, and a mixture of magnesia and grease or resin is deposited in and among the fibres of the substance of which the cloth is formed. The cloth after having had the excess of the finishing materials squeezed out by being passed between rollers or otherwise and then dried, is rendered to a great extent impervious to water.

The use of a compound formed by mixing a combination of alkali and resin, or a combination of alkali and grease, with sulphate of magnesia, is also applicable to the manufacture of paper. The sulphate of magnesia instead of alum is to be put into the paper-engine along with the vegetable size or soap, and therein mixed with the pulp, as alum and the vegetable size or soap generally are; the sulphate of magnesia forms a substitute for the alum, and of its crystals about 332 parts by weight are required to supply the place of 487 parts of alum.

The patentee does not claim the use of the vegetable size or of soap *per se*, either in the stiffening and finishing of goods, or in the manufacture of paper, but he claims "the application of the compound formed by mixing a combination of resin and alkali, with sulphate of magnesia, and also the application of the compound formed by mixing a combination of tallow or other grease and alkali with sulphate of magnesia, both in the stiffening and finishing of goods, and in paper-making, whether the said compound be mixed with any other ingredient or ingredients or not, and without confining himself to any proportions or qualities of the several ingredients used in forming the compounds, or to any particular manner of applying the compounds."

A further improvement in stiffening and finishing textile fabrics is described by the patentee, and consists in "submitting or exposing the cloth or other goods after having been immersed in, or otherwise impregnated with, or having had in any way applied thereto, a solution or mixture of, or containing sulphate of magnesia, or alum, or other salt, having a metallic oxide for its base, to the action of an atmosphere of, or one considerably impregnated with, ammoniacal gas, by which the magnesia, alumina, or other metallic oxide becomes liberated from the acid with which it was combined, and is deposited in or upon the cloth or goods." This part of the patentee's invention, so far as regards the use of ammoniacal gas for causing metallic oxides to be deposited in or upon the

cloth and other goods, is applicable to some of the processes or operations connected with printing calicoes and other goods; for instance, an atmosphere containing ammoniacal gas can be used as a substitute for a mixture of chalk and water, or for a solution of lime, or soda, or potash in water, in causing the deposition of alumina and other metallic oxides, from the acids forming with them salts, and which salts are applied to goods intended to have that style of printing effected upon them called 'padding.' The salt or mixture of salts, or its solution, having been padded upon the calico or other goods, the article, either before or after being in some degree dried, is to be exposed to an atmosphere of, or one considerably impregnated with, ammoniacal gas, after which it will not be necessary to rinse it in an alkaline solution, or mixture of chalk and water. What is claimed in this part of the specification, is, "the causing cloth or other goods, after the same have had in any way or in any degree applied thereto a solution or mixture of any kind, containing sulphate of magnesia, alum, or other salt, whose base is a metallic oxide, to be so acted upon by an atmosphere of, or containing ammoniacal gas, as that the metallic oxide forming the base of the salt contained therein, shall become deposited in or upon the cloth, calico, or other goods."

Another improvement in dressing, stiffening, and finishing, described by the patentee, consists in applying to the goods "a combination of ammonia with lard, tallow, oil, or other grease, or a combination of ammonia with wax, spermaceti, or stearine, or a mixture of any two or more of those ammoniacal combinations, either alone, or mixed with starch or flour, size or gum, mucilage or any other matter." To form the combination, the lard or other grease, or the wax, spermaceti, or stearine, should be softened or just melted, by the application of heat, after which there should be added thereto liquor of ammonia, the mixture being agitated till the combination is complete. When the preparation of the compound is well managed, one part by weight of liquor of ammonia, whose specific gravity is 0·96, is enough for two parts of any of the other mentioned articles. The combination having been formed and allowed to cool under exclusion from the atmosphere, may be diluted and passed through a fine sieve, when the mixture or solution, either alone or with other matter, at the discretion of the operator, may be applied to the cloth or other goods in the manner in which starch or flour size is usually applied. The cloth is then dried and submitted to such other mechanical finishing operation as is desired, the ammoniacal part of the combination which was applied having been dissipated during the drying of the cloth or goods, and the grease, wax, or other matter (as the case may be) being left therein or thereupon. The patentee lays no claim to the formation of a compound of ammonia with lard, oil, or other grease, nor of ammonia with wax, spermaceti, or stearine, but he claims the "application to cloth or other goods in the dressing, stiffening, and finishing thereof, for whatever purpose the said cloth or goods may be intended, of combinations of ammonia with lard, tallow, oil, or other grease, wax, spermaceti, or stearine; and of ammonia with all or any two or more of the other several ingredients, however the said combination or combinations may have been formed, not confining himself to any particular proportions of the ingredients forming the combination or combinations mentioned or alluded to, nor to any particular manner of applying any of the combinations."

The last improvement specified by the patentee, which relates also to finishing cloth and goods, consists in "drying them by the application of the heated air produced by or resulting from the action of atmospheric air or other air containing oxygen, upon charcoal, coke or other carbonaceous matter in a state of ignition." The carbonaceous matter is to be burned in such a stove as is usually employed in warming buildings, and the air resulting from the combustion, instead of being carried directly by a flue into the external atmosphere, is allowed to pass into the room or chamber in which cloth or goods are hung or extended for drying. The drying produced has the effect of giving the cloth what is called by the trade a "hard finish."

## PATENT LAW CASE—THE SOLAR LAMP PATENT ANNULLED.

*Court of Queen's Bench.*

Westminster, June 4, 5, 1842.

(*Before Mr. Justice Coleridge and a Special Jury.*)

*The Queen* v. *Bynner.*

The *Solicitor-General*, *Mr. Kelly*, *Mr. Hindmarsh*, *Mr. H. Hill*, appeared for the prosecution; and the *Attorney-General*, *Mr. M. D. Hill*, *Mr. Crompton*, and *Mr. Webster*, for the defendant.

This was a proceeding by *scire facias*, the object of which was to repeal a patent, obtained by the defendant for the application of a principle of which he claimed to be the inventor, and which he alleged could be applied to any lamp or gas-burner. [For a full description of this patent see *Mech.*

*Mag.*, vol. xxxiv. p. 33.] This principle was the introduction of atmospheric air at a point below the point of combustion, and the deflection of the air by means of metal or other deflectors upon the flame at a point above the point of combustion. The patent obtained by the defendant (and which was now sought to be rescinded) was issued in December, 1837, and the chief grounds on which its validity was impugned was, that the invention was not new; for that the application of atmospheric air in the way described in the patent had been long ago known and practised, and great numbers of lamps had been made upon the same principle. The expired patent of Upton of 1828 was particularly relied on. The present patent was also impugned for want of clearness in the specification. The defence was, that the patent claimed nothing but a new application of a principle; that the principle itself had been vaguely known, and tried to be acted on some years ago; but that it was the defendant alone who had brought it into scientific and useful application, and in substance, that the difference between him and those who had formerly directed their efforts to the same point, was the difference between success and the want of it. A great many scientific witnesses were examined to make out this defence, and the case occupied the court from its sitting on Monday till late on Tuesday afternoon.

*Mr. Justice Coleridge* summed up the case to the jury, who returned a verdict for the Crown.

## NOTES AND NOTICES.

*Diamonds.*—In a paper recently read before the Royal Asiatic Society "on the Mineral Resources of India," Lieutenant Newbold mentions the universal belief among the miners of India that diamonds grow; that worn-out excavations, after a lapse of rest of fifteen or twenty years, may again be examined, and fresh diamonds will be found in them. Although at first little disposed to pay any attention to such a belief, Lieut. Newbold found, subsequently, reason to consider it more fully; and he is now of opinion that the belief is not without foundation. He has generally found that the opinions of the natives on these matters is, in the main, correct; and has himself witnessed the extraction of diamonds, in tolerable abundance, from excavations long neglected as worn out. At many mines the natives content themselves with working the old excavations in succession, which they constantly find profitable after a sufficient lapse of time, although abandoned before as unproductive. The smaller size of diamonds in modern times may perhaps be accounted for on this hypothesis, the cupidity of the contractors not allowing a sufficient interval of rest to intervene between the workings. [We are surprised that so acute and generally so rational an observer as Mr. Newbold, should lend his sanction to such nonsense.] Diamonds are divided by the Hindus into four castes, to which they give the names of their own civil distinctions; the best diamond being called a Brahman, and the lowest a Sudra. The largest recently found was dug up at Punnah, and it was sold for 400*l.*

*Pork and Corn Oils*—So successful have been late experiments, that pork (if the lean part is excepted) is converted into stearine for candles, a substitute for spermaceti, as well as into oil. The process is simple and cheap, and the oil is equal to any in use. Late improvements, also, have enabled experimenters to obtain sufficient oil from corn meal to make this profitable, especially when the residuum is distilled, or which is far more desirable, fed out of stocks. The mode is by fermentation, and the oil which rises to the top is skimmed off, and ready for burning without further process of manufacture. The quantity obtained is ten gallons in 100 bushels of meal. Corn may be estimated as worth fifteen cents per bushel for the oil alone, when oil is worth 1 dollar, 50 cents per gallon. The extent of the present manufacture of this corn oil may be conjectured from the desire of a single company to obtain the privilege of supplying the lighthouses on the upper lakes with this article. If from meal and pork the country can thus be supplied with oil for burning, and for machinery, and manufactures, chemistry is indeed already applied most beneficially to aid husbandry.—*Report to Congress, of American Commissioner of Patents.*

*The "Trident" Steamer*, which is beyond all question as fine a vessel as ever floated upon salt water, has just been put on the Edinburgh station by the General Steam Navigation Company. She was launched early in September of last year, from the yard of Messrs. Wigram and Green, and was constructed under the immediate direction of T. Brocklebank, Esq., and is said, by many naval architects, to be superior to any vessel yet launched from the Royal yards. Some idea of her strength may be formed from the fact, that although but of 1,000 tons, she has more timber in her than the *British Queen*. In length from head to stern she measures 195 feet: her breadth of beam between the paddle-boxes being 31 feet: her engines were built at the Company's works, at Deptford, and her speed is equal to that of any vessel of similar tonnage. The coal-boxes, which surround the engine-room, hold 200 tons of fuel, and she has stowage for 670 tons of goods. Floating on the water, either with or without her cargo, the *Trident* is a surpassingly handsome model; carrying, in hull and rigging, all the strength of the Government war steamers, devoid of their characteristic heaviness of appearance. The quarter-deck is large, and from its height the passengers have a clear look-out a-head of the ship. The main-deck, from the engines not breaking through the decks, as is generally the case, is large and commodious, and forms an excellent promenade well sheltered by the forecastle and quarter-deck from the wind. Cabins adjacent to the larboard paddle-box are appropriated to the first and second mates, that they may always be handy to the deck. Near these is the cook's kitchen, capable of providing for three hundred persons; and large fire-pumps are fixed in different parts of the vessel, which are examined daily, whilst several life-preservers are on deck in case of accident. The engine-room, in which there are three galleries, one above the other, running over the works, is lit by means of reflectors, and regular berths are fitted adjoining the machinery for the engineers and stokers.—*Post Magazine.*



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# Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 988.] SATURDAY, JULY 16, 1842. [Price 3d.

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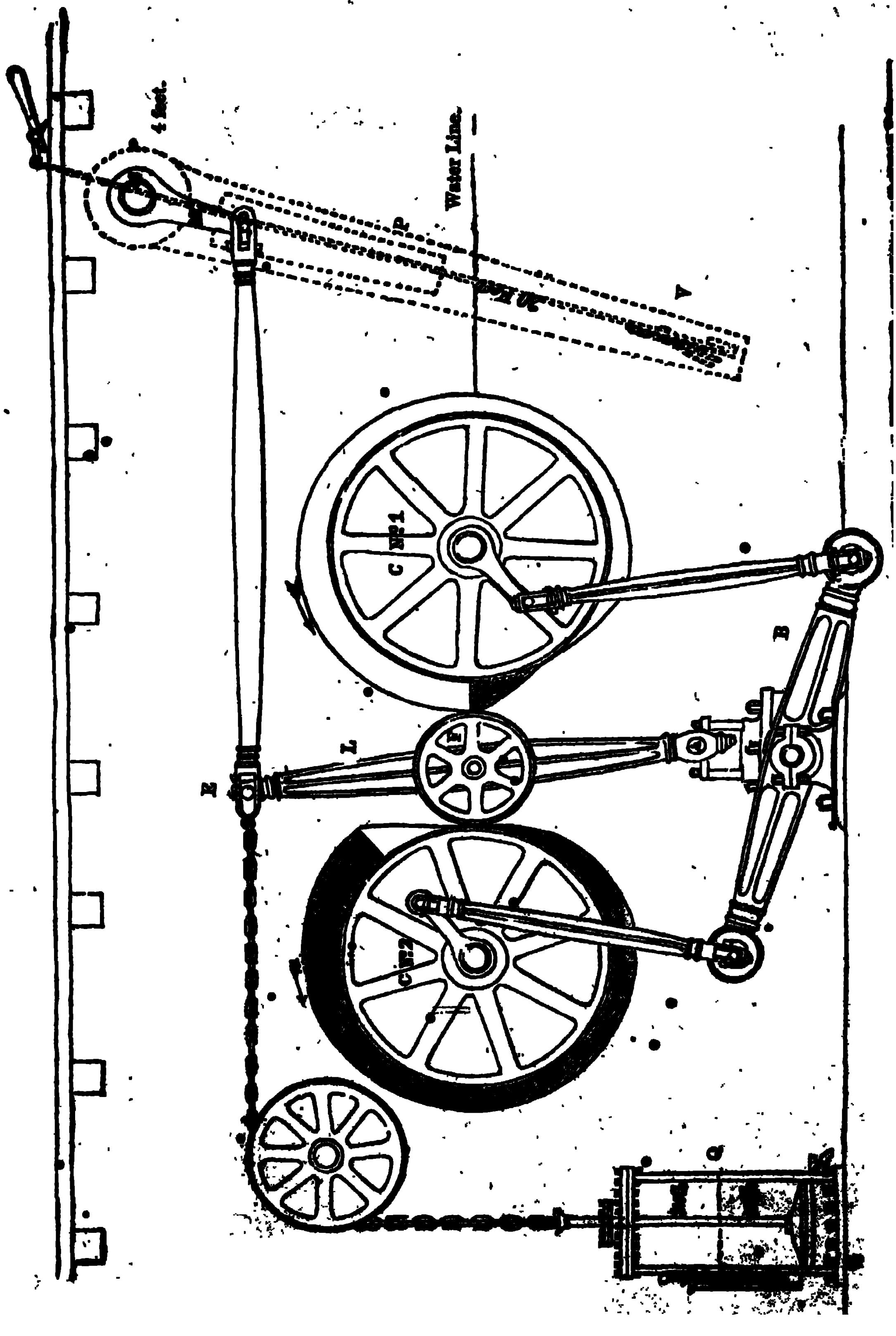



BOOTH'S RECIPROCATING-VALVE PROPELLERS.

## MR. BOOTH'S RECIPROCATING VALVE PROPELLERS, AND NEW SYSTEM OF PROPELLING VESSELS.

Mr. Henry Booth, whose name is so honourably identified with the rise and progress of the railway system in this country, has recently been applying his active and sagacious mind to the kindred subject of steam navigation; and the result has been the discovery of what he considers to be an improved method of applying steam power to the propulsion of vessels through water, for which he has obtained letters patent, and a pamphlet now before us, (anticipatory of his specification,) in which the principles and details of that method are very fully, and we need hardly add, very cleverly explained.*

The pamphlet opens with an investigation of the received doctrine that the mechanical power expended in giving different degrees of velocity to bodies propelled through water is as the squares of that velocity. Mr. Booth "demurs entirely" to the correctness of this doctrine. He says it is not at all recognized on railways, where the established rule is, that "if five horse-power will accomplish five miles an hour, ten horse-power will effect ten miles an hour," and so on; and he endeavours to show, both by argument and by experimental evidence, that it comes all of grievous theoretical blundering, that it has been recognised anywhere else. With the high respect which we entertain for Mr. Booth, it gives us great pain to be under the necessity of saying at once that, so far, his pamphlet is a most signal failure. It is evident, in the first place, from his statement of the "*rationale* of the quadruple ratio," that he does not understand what he has undertaken to refute; and, in the next place, some of the comparative experiments which he cites, are admitted by himself to be entirely in favour of the quadruple ratio, while others are as diametrically opposed to it—a circumstance of opposition which indicates, of necessity, some great error in the conditions of the experiments; for, as he truly observes "facts in natural philosophy never contradict themselves." If Mr. Booth will read and ponder well the "Experimental Equiry" (1794) of our first authority on this as on other mechanical subjects, John Smeaton, a work which we cannot believe he has ever seen—we are persuaded (such is our impression of his habitual candour) that he will himself acknowledge that he is altogether in the wrong; and in the hope that he will do so soon, and that such will be the happy result of his self-examination, we shall refrain for the present from entering more particularly into his very singular heresy.

We cannot, however, quit the subject —even for the present—without expressing by the way our extreme surprise, to see it asserted by so great an authority in railway matters as the treasurer of the Liverpool and Manchester Railway, that, *to double any given speed on railways*, all that is wanted is *double the power*. Seldom has there been a greater mechanical mistake promulgated. If this is to be taken as a sample of the *received doctrines* on railways, no wonder the *received dividends* are so unexpectedly, and hitherto so unaccountably, small. It is of the same class of fallacies exactly, as the oft-exploded one in political economy, that the product of 2 x 2 is always, and of necessity, 4.

What Mr. Booth's heresy in regard to the theory of the quadruple ratio has to do with his patented improvements in ship-propelling, he does not explain; and fortunately, perhaps, for the reputation of the latter, it is not easy to discover. In point of fact, there is no connexion between them. The one may be exceedingly erroneous (as we take it to be), and the other not in the slightest degree affected by it.

The patented improvements of Mr. Booth may be described generally as consisting in a *concentration of the mechanical power* employed in steam-vessels; and this concentration his pamphlet leads us to consider under two heads,— first, a concentration of the power exerted by the paddle-wheels; and second, a concentration of the power produced by the steam-engines.

*First*, then, as to the concentration of the power exerted by the paddle-wheels,

* The Theory and Practice of Propelling through Water, with Observations on the Comparative Resistance offered by Water to Bodies moving through it at different Velocities, comprising also a Description of an improved method of applying Mechanical Power to Steam Navigation.— By Henry Booth, 46 pp. 8vo. Banes, Liverpool; Weale, London.

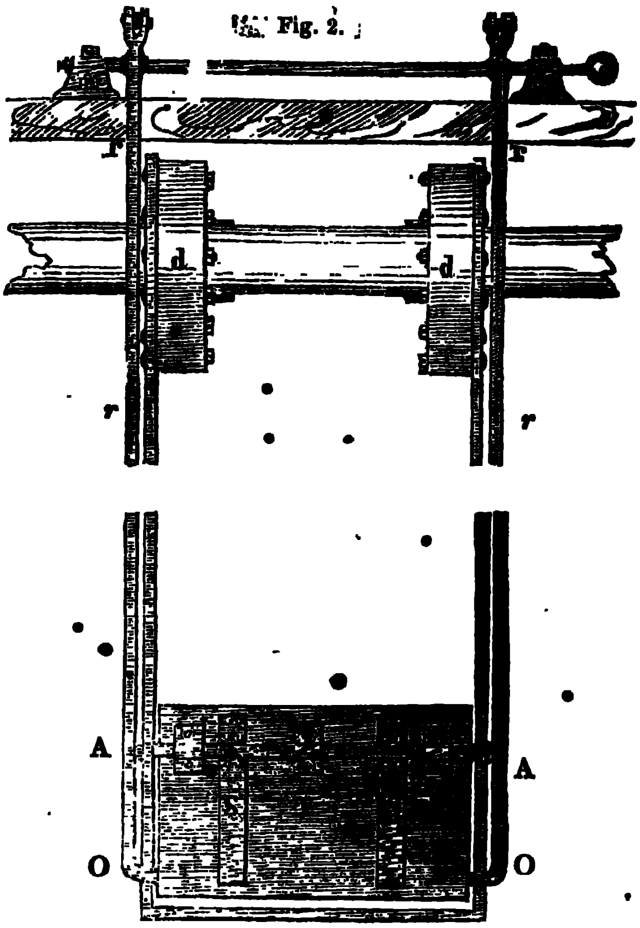
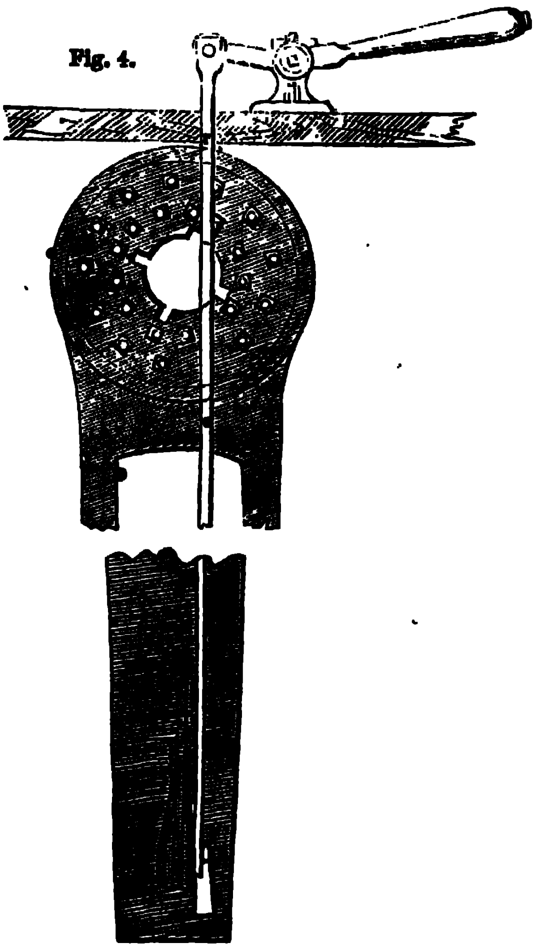


Fig. 2.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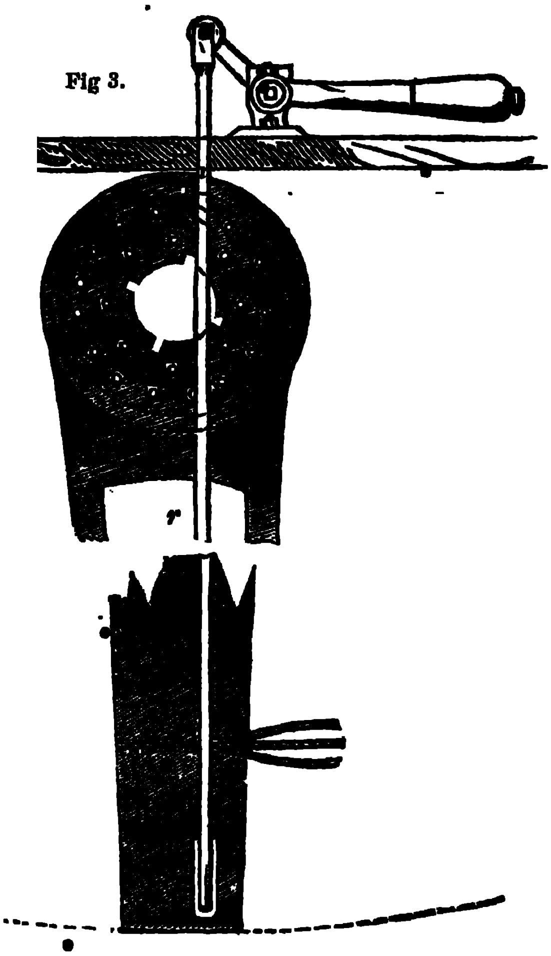
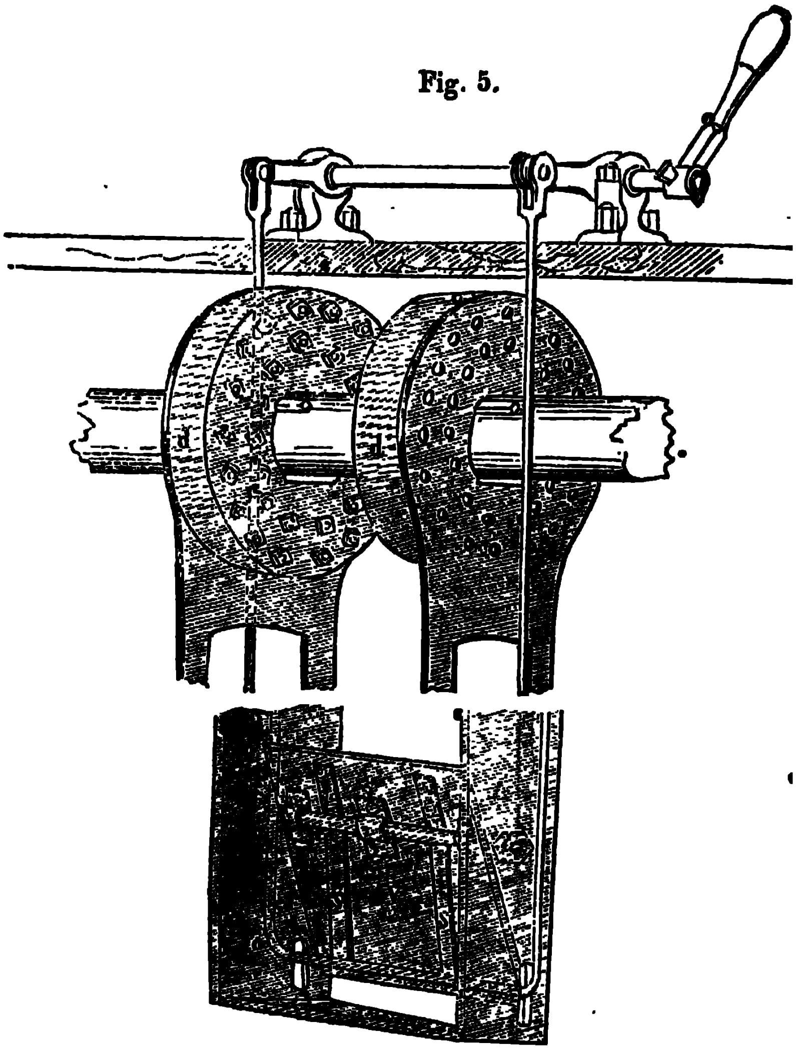


Fig 3.

Fig. 5.



the following is Mr. Booth's own explanation of the means he has contrived for this purpose :—

"The principle, I suggest, consists in a concentration of nearly the whole force of the engine or moving power, into one-tenth or other small portion of each stroke of the piston; and I make use of such concentrated force to effect a proportionably powerful stroke with the propellers; the momentum of the vessel so gained carrying it onwards, through the water, till the next stroke. The moving levers or beams (B), through which the power is communicated, are worked by an engine or engines in the ordinary or most approved way. C No. 1 and 2, figure 1, are cam wheels, which I employ to communicate the power of the engine to an upright lever L, vibrating on its axis (A) at its foot, and connected at the top by rod and crank with the main shaft S, to which the propellers are attached. The crank or short lever, thus fixed to the main shaft *inside* of the vessel, corresponds in its movements with the propellers, fixed to the same shaft *outside* the vessel. P is the propeller—one on each side of the vessel—serving instead of the paddle wheel; the portion of it to which the water offers resistance, and by means of which the vessel is propelled, consisting of a valve plate (V) working on hinges like a valve or door, kept close by a moveable cross-bar, when forced in the direction required to propel the vessel; and, on the return motion opening on its hinge or axis, and yielding to the water, so as to offer little or no resistance; the movement of the propeller or single paddle being vibratory, backwards and forwards, instead of the rotary movement of the ordinary paddle wheel.

"It will be perceived, that when the working beam is in motion, and the cam wheel No. I is made to revolve in the direction indicated by the arrow, the *cam* which occupies about one-tenth part of the wheel's circumference, and which is shaded dark in the drawing, communicates motion to the upright lever L, through the friction wheel F, which moves between and receives its motion from the two cam wheels, and thus causes motion to the crank and main shaft, and consequently to the propellers. The forward or principal motion is effected in one-tenth portion of the whole revolution of the cam wheels (or double stroke of the piston),

the *cam* of wheel No. 1 occupying about one-tenth of the periphery of the cam wheel, while the *return motion* of the lever L, bringing back the propellers with the valves or leaves open (V figure 5), is effected slowly, by means of the extended cam, on the wheel No. 2, also shaded dark, which moves in the same direction, as indicated also by the arrows. This cam (No. 2) comes into operation when the other cam ceases to act, and occupies about nine-tenths of the periphery of the wheel No. 2. The *return motion*, therefore, of the lever (L), and consequently of the propeller, is about nine times *slower* than the primary motion effected by the cam of the wheel No. 1, the engine working equably throughout. The upper end of the lever L, we have stated, is connected with the main crank (M C) which is attached to the main shaft (S), and moves simultaneously, and in the *same direction* as the propellers, constituting mechanically a lever of the third class. But the crank being only 4 feet in length, to a propeller of 20 or 24 feet radius, the velocity of the extreme end of the propeller—that is, of the closed valve plate or paddle-board, is proportionably more rapid, and being also *a great depth* below the *surface* of the water, the effectiveness of the propeller is multiplied in a greatly increased ratio.

"Now, the mode of operation is as follows in the forward or ordinary movement of the engine:—The cam wheels, No. 1 and 2, are moved round in the same direction by cranks and connecting rods, communicating with the reciprocating beam in the ordinary way, regulated by the slow uniform speed of the engine piston, which I will suppose 2½ miles per hour. The dimensions of the engine, cam wheels, levers, &c., must obviously vary with the size of the vessel and other circumstances. In this description, I suppose the engine or engines to have a five feet stroke—the cam wheels to be 10 feet diameter each, making one revolution with each double stroke of the engine. The cam attached to the periphery of the wheel No. 1 in the forward movement, extends along 3 feet of the circumference (about one-tenth of the whole), and projects 15 inches from the circumference in its extreme action, which is consequently the extent of motion communicated to that point of the lever L, which forms the centre or axis of the friction wheel F. This point is half way between the pivot or axis A, on which the upright lever rests and vibrates, and the upper end E; consequently, the upper end E moves 2 feet 6 inches, while the cam communicates a motion of 1 foot 3 inches to the *centre* of the vibrating lever. The upper end of the lever being connected with the main crank MC, communicates to it a 2 feet 6 inch vibrating or bell-crank motion. This crank, or short lever, I suppose 4 feet long, and attached to the main shaft, to which the propellers also are attached (one on each side the vessel), and the propellers I suppose to be 20 feet long from the main shaft to the centre of the valve plates, or paddle boards, or five times the length of the main crank, (10 feet from the shaft to the water, and 10 feet deep in the water); the paddles or valve plates, therefore, will make a stroke of 12½ *feet*, while the crank end moves 2 feet 6 inches in the same direction. Now, this movement or stroke of 12½ feet in the water, is effected while the cam wheel No. 1 moves *one-tenth part* of a revolution, or that portion of the revolution which effects the action of the cam No. 1 against the upright lever L, in the forward movement of the engine; consequently, the propelling stroke of 12½ *feet* in the water is effected while the engine piston moves *one foot*, or one-tenth of a double stroke. If the piston, therefore, moves at the rate of two miles and a half an hour, the propellers will move through the water at the rate of 2½ by 12½, or 31¼ *miles an hour;* the increase of speed being effected by the quiet and smooth motion of the levers; the centre or bearing point of the lever L moving only 1 foot 3 inches in each direction, with each double stroke of the piston.

"The speed of the propelling valve plate is here stated at thirty-one miles per hour, but it is obvious that this may be varied by varying the size of the cam or the proportion of the levers or cranks; or by modifying the *sweep of the cam*, the velocity of the propeller may commence at 12 or 14 miles an hour, (a little below the supposed speed of the vessel, and therefore producing *no* shock), and gradually increase to 30 or 35 miles, and then diminish down to 15 or 20 miles an hour before the end of the stroke.

"Still further, to render smooth the motion of the propeller, a range of springs is placed on each side of the valve plate, to render the shutting action of the plate against the supporting cross-bar smooth and gradual, the springs assisting the opening movement of the valve plate on the return motion of the propeller. Thus, every thing like shock or percussion in the action of the propeller is to be avoided, and a smooth and nearly uniform motion imparted to the vessel.

"It is thus evident that the propelling movement is accomplished in about one-tenth of a revolution of the cam wheel, or one-tenth of a stroke of the engine piston. The duty of the engine during the remaining nine-tenths of the stroke being to bring back, at a slow speed, the propeller with open valve, to keep up the momentum of the heavy cam wheels, and quietly to raise the piston of the pneu-

matic cylinder, which, by its descent is to assist the principal movement or rapid stroke of the propeller."—pp. 22—27.

"Figs. 2, 3, 4, and 5, are separate drawings of the propeller, shown during the action of the valve-plate, and the mode in which it may be thrown out of gear or put into *back* gear, either on one side or both sides of the vessel—or it may be thrown *out* of gear on one side, and continued *in* gear on the other side—or be put in *back* gear on one side, and *forward* gear on the other side, when it is wanted to bring the vessel quickly round; the utility of all which operations will be obvious to nautical men.

"Fig. 2, is a front view of the propeller with the valve-plate closed, (V), the lower edge supported by the sliding cross-bar O. This bar has a motion up and down of about 3 inches, effected by a lever on deck, attached to the bar by two connecting-rods *r r*. When it is lowered down, the valve-plate is *loose*, and will move backwards and forwards on its hinge or axis A A, having no power to propel the vessel either backwards or forwards; but when the bar is raised 3 inches, the lower edge of the valve-plate is forced by the water against the cross-bar O, and the propeller comes into action—and it is evident that, according as this sliding-bar is raised at the *front* or *back* of the valve-plate, the propeller will become efficient to move the vessel either forwards or backwards, which may be done in a second of time at the option of the engineer, on one side of the vessel or both, and either with or without reversing the engine.

"Fig. 3 is a side view of the propeller, showing the moveable bar and connecting-rod, guided in a slot behind the bottom of the valve-plate—the connecting-rod (*r*) extending up to the deck, where it is worked by the lever as before explained, being lowered a few inches, when required to throw the valve-plate out of gear, or to allow the valve-plate to pass to the opposite side of the cross-bar, and so become efficient to move the vessel in the opposite direction.

"Fig. 4 is a side view of the propeller with the valve-plate open, and nearly invisible, the edge of it only being seen."

"Fig. 5 is a perspective view of the propeller."—pp. 28—30.

The "great point" which Mr. Booth considers he has here accomplished "is the saving of fuel, and of expense, in the ordinary working of the vessel," for,—

"The forward stroke being effected during about *one-tenth* of the double stroke of the engine, the remaining nine-tenths of each stroke of the engine having only to bring back at a slow pace the propeller with the valves open, is principally employed in accumulating the *reserved power*, of which we shall speak hereafter—keeping up the motion of the heavy cam wheels, and thus preparing for the next great stroke of the propellers." —p. 32.

Mr. Booth illustrates this view of the efficacy of his reciprocating propellers by the following instances—

"In thus concentrating the moving power into a short interval of time, with afterwards a respite during a longer interval, and so on alternately, we copy the natural movements of those animals whose element is the water. A fish, by the muscular exertion of the tail, is propelled rapidly forward by one strenuous effort, after which the momentum gained is sufficient to keep up the motion till the muscles have recovered their tone for another stroke. The same plan of operation is pursued in a fast-rowing boat where a rapid and powerful stroke is effected with the aggregate power at command, after which there is an interval occupied by the returning movement of the oar, during which the strength is recruited for another effort; the momentum gained, carrying the boat forward in the interval. The principle and general mode of operation which I propose appears thus to be sanctioned by the motion of fishes in their own element, and by the operation of our swiftest boats moved by manual power, in which latter case the alternate effort and relaxation is altogether optional; as in a boat of six oars, instead of pulling all together, the rowers might, if they pleased, pull —two, and two, and two, keeping up, almost without intermission, a multiplicity and continuous succession of *small pulls*, instead of a comparatively few vigorous strokes, with pauses or intervals between, as experience has proved to be the most efficient course.

"Perhaps the best popular illustration of the advantage, and in some cases, absolute necessity, of *concentrated power*, in the propulsion of vessels through water, may be found in the working of a *life boat*. These boats are fitted with ten or twelve oars, and their service being required in storm and tempest, every mechanical means that ingenuity and physical strength can supply is little enough for the accomplishment of the object.

"Imagine a life boat departing for a shipwreck, three or four miles distant, with a hurricane blowing, as is too often the case, right on the land. The life boat has ten oars, with as many men to work them. Suppose the *continuous* plan of working to be attempted, with ten men pulling *in quick succession*, the effort, indeed, is almost *con-*

*tinuous;* but it is the continuous effort of *one man*, and against the tempest and the surge the boat stirs not a foot from the shore. But change the plan of operation; adopt the aggregate and concentrated plan, instead of the separate and continuous. Let the ten men *pull all at once*, and the boat bounds over the wave and makes head against the storm; a pause for a moment ensues after the first stroke, and the tempest seems likely to drive back the boat; but after a brief interval, another pull—'a long pull, a strong pull, and a pull altogether,' (the principle has become a proverb,) the boat again springs forward with quickened speed; its own momentum now keeps it moving during the intervals of the strokes, and by the united and repeated efforts of the ten rowers judiciously applied, finally reaches its destination.

"No single and separate efforts of the ten men, however rapidly applied, *in succession, one after the other*, could have accomplished the object. And in what does the continuous splashing of the ten floats of the paddle wheel during every stroke of the engine—in what does this differ from the disjointed and separate efforts of the ten men in the life boat? The ordinary paddle wheel distributes the power of the engine equally over the whole circumference of the paddle wheel, say 100 feet. I propose to concentrate the whole power of the engine into a strong pull of *ten or twelve feet*, wherein the reserve power is accumulating for the next stroke."—p. 33.

Mr. Booth proceeds, in the *second* place, to explain how he would accumulate or store up the power not made use of during the nine-tenths of the stroke when his propeller is inactive, and give it out when wanted in aid of the efficient tenth. The following is the plan which he proposes for this purpose:—

"Q, Fig. 1, is a pneumatic cylinder, closed at each end. The stroke of the piston will be to the same extent as the motion of the upper end of the upright lever L to which the piston is attached by a chain and wheel, as shown in figure 1, or other efficient mode of connexion. The reserve power is brought into action as follows:—The cylinder Q is to be filled with air more or less compressed by a small force pump. If the stroke of the pneumatic piston is 2 feet 6 inches, the length of the cylinder space should be 5 feet. When the piston is at the bottom, the air must be forced into the cylinder, to the density, I will suppose, of 100 lbs. per square inch (the exact amount of compression to be at the option of the engineer). As the cam wheel, No. 2, moves the propellers slowly back with the valve plates open, the pneumatic piston will be slowly raised, and when the stroke is finished, the area *above* the piston will be diminished one-half, and the density of the compressed air will consequently be double, or 200 lbs. per inch, which, on the return of the upright lever L will powerfully assist the steam-engine or principal moving power in effecting the forward or main stroke of the propeller. If found desirable a small portion of air may be admitted underneath the pneumatic piston, which, being compressed on its descent, will act as an air cushion, to prevent any shock at the end of the stroke. The diameter of the pneumatic cylinder as well as the degree of compression on the air, must be left to the judgment of the constructing engineers. In the drawing (figure 1) the cam of the wheel No. 1 is represented in the position of having just completed its action on the lever L, and propeller P in the principal movement propelling the *vessel forward;* and the cam of wheel No. 2, just about to commence the slow backward movement by which the reserved power is raised, and the levers or propellers quietly brought back and placed in position for the next effective stroke."—p. 27.

Mr. Booth calculates that the gain which may be effected by this double concentration of power is actually as ten to one!

"We will suppose that it is desired to make the forward stroke of the propeller equal to the pull of a thousand horse. If the concentration be *ten-fold*, a steam-engine of a *hundred* horse power should suffice; or, to cover extra friction, &c., say, 200 horse may be required. The *pneumatic cylinder and cam wheels will effect the rest.* A cylinder 3 feet diameter with a stroke of 2—6 and charged with air at 100 lbs. per inch pressure, and slowly compressed into about one-half its bulk, would answer the purpose."—p. 40.

Mr. Booth anticipates that people may wonder how he is to get a valve plate or paddle-board large enough to act as a fulcrum to his thousand horse pull or lever; but he gives the following reasons for believing that one of corresponding dimensions will not be at all required; that, in fact, "a very small" one will answer every purpose.

"I will admit that in the proposed scheme it will be desirable to have valve plates large enough to meet *a far greater resistance* in the water during the main stroke of the propeller, than the resistance at present offered to the paddle wheel during the same extent of motion. But a small valve plate or paddle board will accomplish this object. I shall suppose that on the proposed plan the pad-

dle board will be three times as deep in the water as the floats of the ordinary paddle wheel. By the law of hydrostatics, this condition would give five times the power to the *water as a fulcrum* of resistance, which is its proper function in relation to the paddle board. Consequently a paddle board of *three square feet* area would be as efficient at the increased depth as one 15 feet area at the lesser depth; but that is not all. The vibrating propeller may, in its principal movement, be made to move *twice as fast* as the paddle wheel, which will increase the efficiency again of the *fulcrum* probably two-fold additional, making the 15 feet equal to 30. I think there need be little apprehension, therefore, respecting a very small valve plate being sufficient to give out the requisite power, the comparison being between *deep water and high velocity* in the valve plates, and *shallow water* and a *slower motion* in the ordinary paddle boards."—p. 41.

Assuming that Mr. Booth is right in his new theory of concentration, and the new practice which he seeks to found upon it, this grand practical result would follow, that the whole marine steam power of the country might be at once multiplied tenfold; or, to make allowance, as he says, for such matters as "extra friction, &c.," say fivefold. Every vessel of 100-horses power might at once be converted into one of 500, and the *Penelope*, of 650, now on the stocks, might have her unparalleled magnitude increased to the prodigious amount of 3250-horses power! You have but to adopt Mr. Booth's reciprocating valve propellers, cam wheels, and pneumatic cylinders, and behold the prodigy achieved!

But can such things really be? Can the true principles of steam navigation have remained so long hidden from the anxious scrutiny of the many eminent men who have devoted themselves to their elucidation, that it should have been reserved to Mr. Booth to pour, all at once, such a flood of light upon them? Mr. Booth who knows so little of the science of his own particular business, railway transit, as to suppose that *double power, double speed*, is the rule by which it is regulated? However possible, it is assuredly not very probable. We do not hesitate to state our own strong impression to be, that the whole affair is a delusion—very ingeniously conceived, and most skilfully and plausibly advocated—but still a delusion. We have not left ourselves room to refute in detail Mr. Booth's various positions, but we shall add a few general observations, which may serve to indicate the grounds on which we rest our opinion.

The concentration of effort which Mr. Booth proposes to accomplish by his reciprocating-valve propeller, though treated by him as something quite new, is no more than has been tried to be accomplished many times before; it is the object of all the feathering paddle-wheels which have ever been invented; and the object also of every sort of wheel in which it is endeavoured to place the floats so that they shall only act against the water when they can act with advantage. A paddle-wheel, the floats of which act only during the front half of each revolution, is just as good an example of intermitted action, as the case of the boat with its ten rowers, so much dwelt upon by Mr. Booth. The paddles, it is true, act one after the other, while the rowers act all together, but the difference in time between the two operations is so extremely small, as, in all probability, to reduce them, in point of efficiency, to a very near equality. Between the single reciprocating propeller of Mr. Booth, however, and the boat with its ten rowers, there is really no analogy whatever. Mr. Booth proposes to do by one stroke what the rowers do by ten, and he talks as confidently of doing it as if it were a thing of the greatest ease imaginable, whereas, in point of fact, it would be found just as difficult to throw the power of a thousand horses into one pull, as for ten men to apply their hands to one oar. Numerous experiments, of unimpeachable authority are on record, which show that it is impracticable to obtain from one arm or propeller the same degree of velocity which is obtainable from a number. What the best numbers are, according to different circumstances, such as area of floats, power applied, &c., may not have been ascertained with perfect exactness; but there has been enough, at all events, determined, to justify us in pronouncing Mr. Booth's single propeller to be altogether out of the question. Nor do we think he will mend his case much, either by the greater depth or the greater velocity which he proposes to give to his propeller, (on the former of which points he evinces some strange notions,) since that would still leave the distribution of force as it was before, and it is there, the fallacy of his system appears to us chiefly to rest.

## ON MR. HOULDSWORTH'S PYROMETER—BY C. W. WILLIAMS, ESQ.

Sir,—I have now to lay before your readers the results obtained from one of the simplest, yet most valuable adjuncts to a furnace that has yet been applied. So vague have been our modes of testing the comparative values of what are ignorantly called "Smoke Burning" Plans, that, (probably from the want of something practically more efficient,) we seem to have quite overlooked the object of which we are in search. Having adopted the *boiler*, with all its varieties and imperfections, and its fluctuating power of evaporation, as the instrument for testing the heating powers of the various descriptions of coal, or the efficiency of the several modes of constructing and managing our furnaces; we thus take one, and a very imperfect class of vessels, *mechanically* considered, as an index of the efficiency of a wholly different class, *chemically* considered.

In treating of combustion, as regards the use of coal, our object manifestly is, to discover the best construction, arrangement and management, of a furnace towards obtaining the greatest quantity of heat from any given quantity of the fuel. Instead of endeavouring to ascertain this measure of heat in the furnace, or flues leading from it, we inconsiderately apply ourselves to measuring the quantity of water evaporated from the boiler placed over such furnace; and this without the slightest reference to the good or bad faculty of such boiler, in absorbing and applying the heat, or even endeavouring to ascertain whether more or less heat is so absorbed, or how much is lost by the chimney shaft.

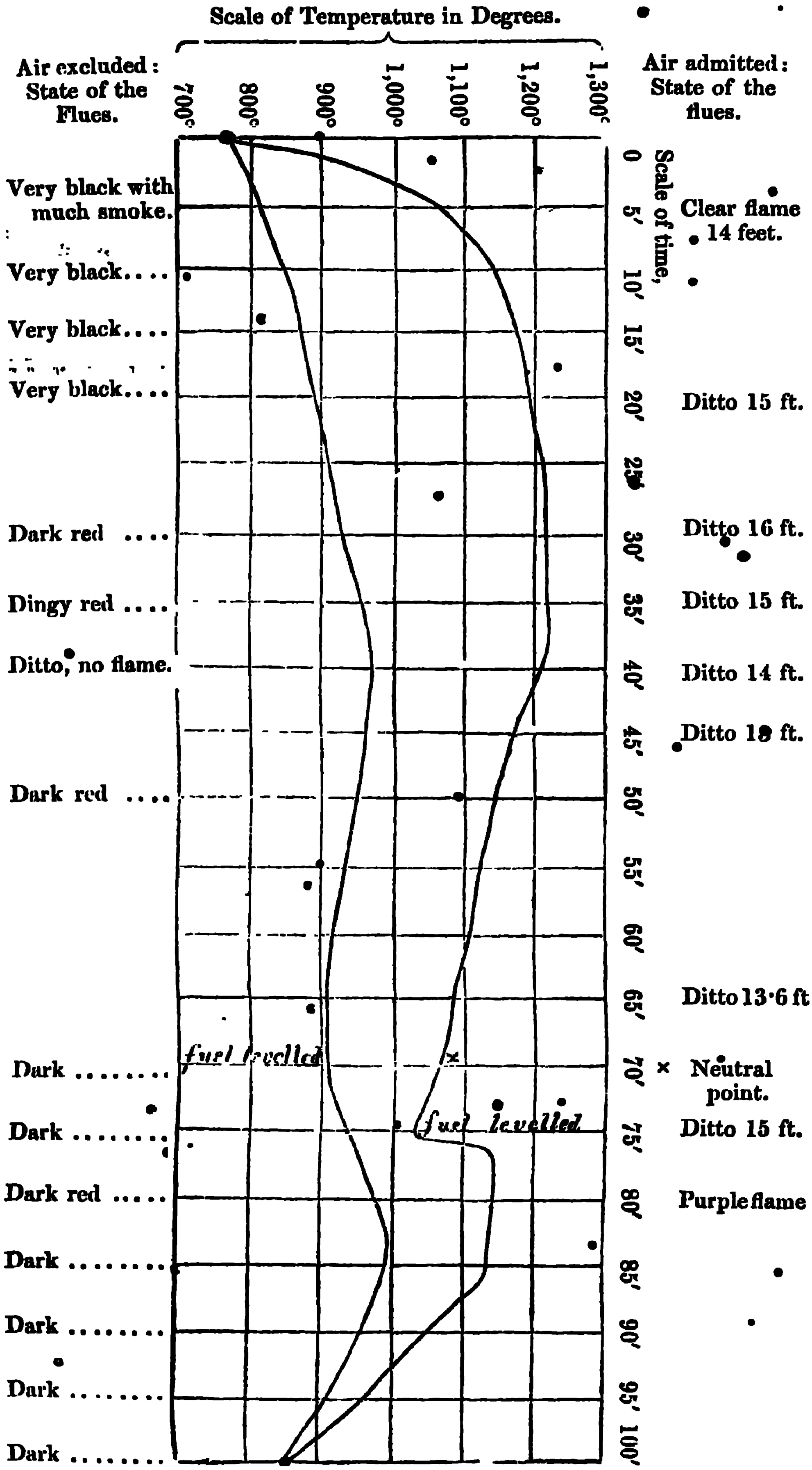
Thus, instead of applying ourselves directly to the object of our enquiry, we refer to a class of secondary, and manifestly uncertain data. So prevalent, indeed, is this mode of testing the heating properties of different kinds of coal, or arrangements of the furnace, in promoting combustion, by reference to the quantity of water evaporated by the boiler, that we fall into this erroneous practice, and yield ourselves up to a fallacious mode of reasoning and experimenting, which would not for a moment be sanctioned in any other mechanical or scientific pursuit.

This most fallacious test of the chemical process of combustion by reference to the mechanical process of evaporation, seems to be dependent on no better ground than that, practically speaking, we have none other. This may be admitted as a reason for its adoption, but can be none for its justification, or for our apathy in searching for a more trustworthy one.

I am now, however, enabled to state, that there is a simple and direct mode of obtaining the desired results, and of testing the boiler and the furnace by reference to their respective functions and modes of action. Let it be understood, that in testing the value of any mode of constructing or managing a furnace, and particularly as regards the admission of air to the fuel in effecting the most perfect combustion, our object is to ascertain by which method we obtain or generate the largest measure of heat—leaving it to another, and different class of experiments, as to the best means of applying such heat.

In a communication made by me at the Victoria Gallery, Manchester, and to the Mechanical Section of the British Association, I stated, that in pursuing the enquiry, on the large scale, as regards combustion, and the modes of producing the greatest quantity of heat from any given weight of coal, I found it absolutely necessary to discard the boiler *in toto*—that the uncertainty which exists as to the evaporative powers of the various kinds of boilers in use was such, that no reliance could be placed on the results obtained through their means. I asked what test, rationally and mechanically considered, can boilers, with their peculiar and variable faculties of absorbing heat and generating steam, furnish, towards ascertaining the proportion of the furnaces in generating heat, or the various descriptions of coals in their combustible proportions? And who can determine how much of the heat generated does this or that kind of boiler absorb or apply? My eyes were thus opened to the defective mode of obtaining results, by applying the evaporative economy of a boiler, as a test of the heat-generating power of any kind of coal or mode of managing the furnace. I found a large evaporative economy from one kind of boiler, when combustion was manifestly imperfect in the furnace, and a great deficiency of evaporation in another, where combustion was nevertheless complete, and a much larger measure of heat ob-

MR. HENRY HOULDSWORTH'S THERMOMETRIC DIAGRAM, SHOWING THE FLUCTUATIONS OF TEMPERATURE IN THE FLUES OF A BOILER, ON THE NEW AND OLD SYSTEM.



tained from the fuel. I saw, in fact, that the error lay with the boiler, and was forced to the conclusion, that in treating experimentally of the furnace and its management, particularly as regards the admission of air, the furnace alone, and its heat-generative powers, must be tested, and apart from the boiler.

How then was this heat-generative economy to be ascertained? I suggested three modes. 1. By means of thermometric bars, the heat being conveyed to the thermometer by the conducting power of the metallic bar. 2d. By the use of a series of metallic alloys, introduced into the flues, and which, being fusible at varying and ascertained temperatures, would indicate the temperature existing in the flue. 3d. By means of a pyrometer constructed of a number of metallic bars, united by a system of compound levers, the expansive power of the bars being transferred to an index placed outside the boilers. These several modes of ascertaining the internal heat in the flues had their inconveniences, on which I need not here dwell.

At the late Meeting of the British Association in Manchester, Mr. Henry Houldsworth described his very simple and useful Pyrometer. He is reported to have said (see the last number of the *Mechanics' Magazine*, page 32,) that "he had that morning fitted up a contrivance for ascertaining the comparative temperature of the flues under different circumstances which had not previously been very satisfactorily ascertained. Mr. Williams had used a thermometer, inserted in a bar of iron," (copper,) "which was placed in the flue; but he (Mr. Houldsworth) was not satisfied with that plan, and had passed a copper wire through the flue from one end to the other. This was kept in a state of tension by weights, and by its expansion or contraction acted upon an index, which gave a very correct measure of the relative temperature. He had tried some experiments with it, and had obtained very satisfactory results."

At a subsequent Meeting of the Association, Mr. Houldsworth said, that, "Since the discussion on this subject he had made some careful experiments with the Pyrometer which he then described; and the results were, in his judgment, exceedingly satisfactory and conclusive. These experiments were made upon a furnace fitted up according to Mr. Williams's patent, by putting three cwt. of coal upon the fire two different times, the fire being each time in the same state, and the temperature of the flue, as indicated by the Pyrometer, being in each case about 700 degrees. On one occasion, the air passages were left open, in the other they were closed; in each case the experiment was continued for 100 minutes. In the experiment in which the passages were left open, the average temperature of the flue was about 1,100 degrees; in that in which the passages were closed, and Mr. Williams's apparatus thrown out of use, the temperature averaged only about 900 degrees. During the whole time of the former experiment, there was an entire absence of smoke; during great part of the latter, the flues were filled with smoke. Mr. Houldsworth exhibited a diagram, showing in a very striking manner, the results of his experiments." I now send you a copy of the diagram exhibited by Mr. Houldsworth on this occasion. (See preceding page.)

So sensible was this pyrometer, that it registered the degree of cold produced by the mere act of opening the fire door. Mr. Houldsworth also stated, that he tested the effect of admitting or excluding the air every five minutes, and on each occasion the lowering of temperature in the flue by closing the air aperture was rapidly indicated by the Pyrometer. A remarkable proof of the rapidity with which this Pyrometer indicates the change of temperature in the flues, is shown in the diagram. On the charge of 3 cwt. of coal being thrown on the furnace, much carburetted hydrogen gas is of course evolved. If air be so admitted as to effect its combustion, a large flame is instantly produced and a corresponding heat. But if the air be excluded, the gas is converted into smoke, and the temperature in the flues rises but gradually. These two changes of a sudden elevation of the temperature in the one case, and a slow one in the other, are strikingly marked in the diagram, from the starting point. So again, when, at the end of 75 minutes, as marked on the first experiment, (see the upper line,) when the fuel is levelled on the bars and the air prevented rushing up in too large masses, the temperature rises suddenly, above 100 degrees in about two minutes;

whereas, in the second experiment it rises very slowly on the fuel being levelled at the end of 70 minutes, namely, 100 degrees in 15 minutes. A study of this diagram will explain many important features in the management of fuel in a furnace, and Mr. Houldsworth has conferred a great advantage by thus giving us so practicable a means of ascertaining what hitherto has been beyond our reach. The importance and application of this ingenious adaptation of the expansive power of the wire I will further explain in my next communication.

I am, Sir, yours, &c.

C. W. WILLIAMS.

Liverpool, July 11, 1842.

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ON THE ATMOSPHERIC RAILWAY—MR. CLEGG'S PATENT—MR. VIGNOLES' REPORT TO THE BRITISH ASSOCIATION, AND MR. PIM'S LETTER TO LORD RIPON. BY J. R. HILL, ESQ., C. E.

Sir,—I had imagined from the very little that was said of the above undertaking during the better half of the bygone year, that there was but small chance of its ever again being brought before the public, but the events of a short time past have proved the reverse. I am induced therefore to send you the following remarks for insertion in your valuable and widely-circulated work.

It appears that a contract has been entered into by the patentees, Messrs. Clegg and Samuda, to lay down about two miles of pipes with the necessary exhausting apparatus and "all appliances" on the Dublin and Kingstown Railway, and that its adoption has been strengthened and tacitly sanctioned by the opinion expressed of its practicability by the government inspectors, Colonel Sir Fred. Smith, and Professor Barlow, given in a former number of your work; but even with this government authority in its favour, its adoption by the Dublin and Kingstown Railway Company, and the very favourable opinion of Mr. Vignoles, it still appears that the science of pneumatics, as proposed to be applied for propulsion, has been but slightly investigated.

The great Papin, with his mechanical genius, of which it must be allowed he had more than an ordinary measure, totally failed in his attempt to drain mines at Auvergne, and Westphalia, by the employment of compressed air in pipes to work his water machines at a distance from the source of power, though it is said, all his preparations were extremely well made, the joints very tight, &c. Having been disappointed in his expectations with compressed air, he converted his apparatus to the exhaustion principle, but "the machine at the mine stood still as before." And I think I may venture to hint, that Papin's abortive attempt at pneumatic draining was not much less inferior to the best arrangement of the celebrated Cornish Pumping Engine and pit work, than the exhausted pipe railway with its valves, pistons, coulters, &c, made in the very best manner, and with all the improvements of the age, is to the best locomotive engine and common railway.

Most of your scientific readers will remember the attempt made at St. Catherine's Docks a few years since to work the cranes or hoisting machines by vacuum pipes and pumps, and of its total inefficiency, though this would appear a much more favourable case by having truly bored cylinders and pistons well fitted, than the continuous railway pipe and valve with its rough inside and coat of grease. I have witnessed two or three failures with private individuals, also, under the most advantageous circumstances. It is true that there are at this time many small vacuum machines at work, but the circumstances and conditions are very different.

I could enter into this part of the subject by describing a number of other cases of disappointment to projectors, in compressing, as well as exhausting air for the transference of power, but which would be a waste of your pages to dwell upon. Had this pneumatic scheme for railway propulsion been based on a sound theory, and of advantageous and practical application, there is no doubt of its being invaluable, not only for this purpose, but also for a variety of others; but the experiments shown at Wormwood Scrubbs, and the reports thereon are, in my opinion, very unsatisfactory, and far from being conclusive; and altogether there appear so many circumstances to detract from its efficiency as to leave but small chance of its ever being useful in the way proposed.

*Mr. Clegg's Patent.*

The only points of originality in this patent appear to be the valve covering the slot in the pipe—the mixture of tallow, &c. to make it air tight—the using of a heated iron to make the mixture fluid, as the propelling carriage passes, and the cover over the valve to keep off the rain, snow, &c. I have not the slightest doubt but the idea of using the composition for sealing, combined with the heater, is original; it is ingenious, and deserves a better cause. Had the vehicle and heater been required to move at the rate of Russel's broad-wheel wagon of 2½ miles per hour, there would have been some chance of the heater plan being successful; but at a speed of 30 miles an hour, or 44 feet per second, success is highly improbable. It is said that the sealing mixture may be adapted to the temperature of seasons; but even this cannot be practicable for the hottest summer's day, and coldest winter night, with the same materials; nor can I imagine the possibility of changing the sealing mixture on a long line of railway, so as to adapt it to the varying temperature of a winter's day and night. For any purpose when the velocity of the heater may be so slow as to render the sealing material sufficiently fluid, the invention deserves all the encomiums bestowed upon it; but for the purposes of actually *working* a railway, at ordinary railway velocities, I think there is every prospect of a total failure.

If my views of the matter be correct, there are, then, two causes which militate most strongly against the pneumatic railway. 1st. The philosophical fact of great retardation to the flow of air through great lengths of pipes, whether it be compressed to a greater density than the atmosphere by being *forced in*, or rendered more attenuated by being *drawn out*, which I will call plus and minus conditions; besides the enormous waste of power arising from friction of pistons and other mechanical causes. And, 2d, the great apparent difficulty of rendering a valve the entire length of a railway sufficiently air tight by any means practicably applicable to this purpose.

Considering that air rushes into a vacuum at the rate of upwards of 900 miles per hour, it will easily be conceived that a number of very small leaks, even if the sealing apparatus and plan were moderately successful, would occasion the necessity for a great deal of station engine power beyond what would be necessary for the traction of trains.

But if my observations be incorrect, or founded on wrong data, I have a hope that some competent advocate for the scheme will be kind enough to set me right. Such plans as the Pneumatic Railway being brought forward and sanctioned by talented men, and under the patronage, support, and influence of great names, by which the current of public opinion is too often guided, ought to be such as to bear a fair investigation, and to prove, on analysis, that it is, as Mr. Booth says, "an object worthy of the statesman and the philosopher to give a right direction to public expenditure and prevent the reckless waste of the national resources."

*Mr. Vignoles' Testimony.*

The paper read by Professor Vignoles at the British Association gives a most popular, lucid, and clear description of the Pneumatic Railway, and would be listened to with great attention, and carry with it the favourable opinion of many of the audience; but there are a few passages in the paper which I think claim particular attention. Mr. Vignoles says, his object in bringing the subject forward is to "invite discussion—to court inquiry—to elucidate truth, and to lead ingenious men to discover, through the numerous secrets of nature, more economical means of producing motion." The whole of the sentence is highly honourable to the learned professor, and affords me encouragement in approaching a few points of the subject, to which it is apparent Mr. Vignoles had not given much consideration.

My first remark applies to admitting the air behind the piston, and thereby avoiding, as alleged, "a vast amount of friction, as experiment had proved it gives at least 99 per cent. more of the whole effective pressure of the atmosphere." My construction of this sentence (which probably is not remarkable for perspicuity) is, that the impelling force of air entering the pipe at the back of the piston, is about twice as much as it would be if it entered at the end; but this 99 per cent. can only be due to a determinate velocity and distance from the end of the pipe, both of which will have a most material influence on these figures.

I will therefore assume that the distance contemplated is the average distance of the stationary engines, and the velocity thirty miles an hour, as that velocity only has been mentioned. Now as the pipe must first be prepared by the air being drawn out or exhausted in front of the piston before any power can be exerted by its rushing into the pipe, and urging the piston forward, tending to restore the equilibrium, and as it cannot be drawn out close in front of the piston, similar to its admission at the back, but only at the branch leading to the station-engine (the distance of which I will assume to be the same as above) it is perfectly clear that the expenditure of power to produce the rarefaction must not only be equal to the power required to propel the train, but must be increased by 99 per cent, according to the alleged experiments, to compensate for retardation of air in the pipes, and also by probably 33 per cent. for the resistance arising from the friction of pistons, the cohesion of the sealing material, and atmospheric pressure on the valve, the rigidity of the leathern hinge of the valve, the occasional drag of the coulter against the sides of the slot, the lifting and closing the valves by the rollers, the minute leaks which are inevitable at the continuous valve, besides the friction and leaks at the station air-pumps, &c., &c.

In consequence of some error of the press, I cannot comprehend the kind of groove to contain the sealing composition, "1 inch wide, and 1½ inches diameter," and I am equally unable to imagine how a few grains of charcoal within a hollow piece of iron can be sufficient to impart the heat necessary to seal the valve at the velocity of railway trains.

Mr. Vignoles says that the pipes when cast in the rough, have a cutter passed through them; it may be therefore inferred that they are *bored* flanch pipes, and that there is a projecting fillet on one end, and a corresponding cavity at the other, to facilitate the fixing and to keep the internal surface even, and that the insides of the pipes have a lining of tallow. All this appears very proper and necessary for the *experiment* about to be made.

Mr. Vignoles also says that existing railways may, with a very trifling expense, be adapted to the pneumatic principle. There is no doubt that if the pneumatic principle could be shown to possess such decided advantages as are described, over the ordinary railway, there are companies who would adopt it, even at a considerable sacrifice, which would ensue in the stock of locomotives, coke establishments, &c., although the expense of such alteration on any principal line, I imagine, would not be much less than 5000*l.* per mile, for pipes, valves, stationary engines, air-pumps, and all the paraphernalia, besides additional stone blocks for stone-laid rails, and sleepers for those of continuous timbers, and this too for a single line, with which no one would now be satisfied.

### *Mr. Pim's Letter to Lord Ripon.*

On reading this letter most carefully, I think no one can fail to be convinced that Mr. Pim is most enthusiastically enamoured of all the beauties of the bright side of the pneumatic plan, embracing a saving of about ⅔rds in the first cost of construction, and a corresponding reduction in charge to the public for its use, with almost perfect safety to passengers; whilst the dark side of the disadvantages (to which I have before alluded, should they be found to exist) does not appear to have claimed an equal share of attention from his capacious mind. Before it can be established that such business or commercial advantages can be obtained, it is first necessary to ascertain that the scientific or philosophical basis on which the plan is founded, be correct (which I will not again enter on,) and afterwards that the engineering premises and means are adapted to the end desired.

### *Slopes.*

On looking at Mr. Pim's sections it would almost appear that there was some secret source of safety in the pneumatic plan against the slips and dislocations of earth-work which are now so frequent, and, I believe, have been the cause of as great a loss of life and general accidents as almost any other; but seeing that such take place in excavations and embankments where the slopes were considered by competent practical men to be angles of repose and safety, it is difficult to imagine that safety or stability can obtain by increasing the vertical angle of 2 to 1 to 1 to 1, as shown by Mr. Pim's

sections; but on the contrary, that while a slope of 2 to 1 is perfectly safe, and may stand for thousands of years; a slope of 1 to 1 could not stand a single day, even if it could be so constructed. It will be said, that embankment slips take place in consequence of the great weight of the engines and tenders, which to a certain extent, may probably be true, but the argument does not apply to cuttings, and therefore I think it will be admitted that the saving in slopes can form but a very insignificant item. Had some of our talented and practical engineers paid a little more attention to the nature, strength, and stability of ground, and spent a little more of the Company's money in the original construction, it would have proved good economy.

*Gradients.*

Mr. Pim evidently contemplates great saving in first cost by making steeper gradients, and providing an increase of power "at the place of difficulty." Had Mr. Pim's deductions and arguments proved the advantageous practicability of first working on a *level*, he might then have undertaken to go *up hill;* but if by scientific inquiry, sound theory, and practice, it is found preferable to cut through the hills at moderate gradients, and occasionally to use assistant locomotive engines, instead of going over the hills by the use of stationary engines, and common hempen ropes, I fear there is but a slight probability of our ever seeing trains drawn over a steep incline by a rope of air.

*Tunnels.*

The saving to be obtained by narrower and lower bridges and tunnels need not be much dwelt upon as they must be regulated by the nature of the traffic expected. If for merchandise only, a *hole* sufficient to permit the trains and loads to pass without touching would be all that is really required, but as the conveyance of passengers is the great source of revenue, there can be no doubt but that the railway directors adopted sound policy in making these passages convenient, capacious, and lofty, not only on account of the heated air, gases, and steam from the engines, which will mostly ascend to the roof, but also to afford more perfect circulation and ventilation.

*Engines, Carriages, and Accidents.*

Mr. Pim is no doubt correct in his view of the matter, in alluding to the engine and tender (of 20 tons weight) and to unnecessary friction, being unproductive to the shareholders; but they must be content to use such a necessary means until a better be provided, with the rails of three times the weight of what he proposes, with embankments and slopes calculated *to stand*, and with a sacrifice, according to Mr. P., of 1900 *per cent.* for the maintenance of locomotive power over stationary power. Mr. Pim next adverts to the delays incident to the slipping of wheels (perhaps a fraction per cent.), "the freezing of pumps" (which, if it does take place, must proceed from inattention, &c.), and to the less weight of materials in the construction of the carriages by their "not having to sustain the shock and tug of the engines." By careful engine driving, and management of trains, I think this shock and tug are of small importance. Had Mr. Pim suggested that the carriages generally started should be made lighter, and the buffers more active and sensible, it would probably have claimed particular attention; for there appears to be a much larger quantity of materials used in the construction of railway carriages, considering the smooth and even planes they have to roll over, than in the ordinary common road vehicles to carry a proportionate load over the most uneven and jolting roads.

Accidents arising from crank axles breaking, or other derangements of engines, would be avoided by the atmospheric plan; but *carriages* sometimes get off the rails by inattention to some of the working details, and *not* because they are not propelled by the atmosphere.

Atmospheric resistance has also been spoken of, but surely the poor engine has sins enough of its own, amounting to the weight of 20 tons, without deserving more than its fair share of this also. Mr. Pim thinks that "60 miles per hour may be easily, economically, and safely obtained by this means;" but probably did not consider that at such a velocity the atmospheric resistance will be according to the best authority, upwards of 14lb. on each superficial foot of a flat surface, and which, on a number of carriages, will be very considerable. I am not aware of any experiments having been

made to ascertain the plus pressure in front, or minus pressure (if any) at the back of a carriage in rapid motion, but think it well deserves the attention of those interested in such enquiries.

Mr. P. proposes to use the spare power of stationary engines, at three miles apart, to grind oats or wheat, saw stones and wood, drain and irrigate lands, &c. The advantages of such arrangement evinces judgment, for by placing one engine in a farm-yard, with the necessary grinding machinery (and threshing too) a second by the side of a soft stone quarry, a third in a timber yard, and a fourth by a morass; then, by suitable machinery for cutting stone and timber, and using the pneumatic pipes for hydraulic purposes, the steam-engines will be beneficially employed, when not otherwise required. Mr. P. appears to calculate in some cases on natural supplies of water to supersede steam power, but as the schoolmaster, the miller, and the manufacturer, have been abroad, there is but very little chance of such sources being found in any situations in Great Britain where railways are required.

I fear I may have prolonged this paper to a tiresome length; but on considering the project most fully, I found I could not do it justice in less compass; and, even now, there are some omissions, which, should you deem it of sufficient importance, I will supply in a future communication.

I am, Sir, your obedient servant,

J. R. HILL.

### THE ATMOSPHERIC RAILWAY AND ITS ORIGINATORS.

Sir,—Perceiving that the pneumatic railway system is about to be adopted in Ireland and elsewhere, I think it my duty to call your attention to the *original claim* of an enthusiastic and talented gentleman, Mr. Vallance, who, in 1818, was the first to project and to *construct* and put into actual use a pneumatic railway at Brighton. Lord Holland, the Duke of Bedford, and many wealthy men rode in Mr. Vallance's pneumatic cylinder railway of about 200 yards long. True it is that Mr. Vallance's plan consisted in driving, or rather sucking the carriages through a large cylinder, so that the passengers had no other light than that of lamps. But he was the first introducer of the idea. Mr. Pinkus, many years afterwards, thought of having the carriages outside and connected to the pneumatic valve in the cylinder by an arm passing through a slit in the cylinders, and progressively closed by a leathern strap, so that the carriages might have the advantage of being above ground and in the open air, as on any other *super*-terraneous railway. No doubt but that if the strap valve can be kept air tight, this is the best plan. But it seems to me an injustice to Mr. Vallance, not to notice his pioneering labours, Mr. Vallance has also invented an excellent and effective apparatus for making ice by the ministration of carbonic acid gas, which will be of great benefit on board ships in tropical climates, as it will make the cabins delightfully cool.

Yours obediently,

F. MACERONE.

### NOTES AND NOTICES.

*Premiums for Essays on Railways.*—The French Academy of Sciences have, on the suggestion of M. Blanqui, offered a prize for the best essay sent in before the 30th September, "on the influence of the establishment of great lines of railway and steam navigation on the development of public riches and civilisation."

*Mining in Turkey—Curious Discoveries.*—A few Turkish gentlemen have lately got up a small company to work a copper mine not twenty miles from Constantinople. In the course of their labours the men turn out, beside ore, petrified plants, flowers, insects, &c.; and the other day they found, at a depth of thirty-two fathoms below the surface, a perfect and well-baked brick, black as the dark soil in which it had lain for so many ages. It is, we understand, preserved for the inspection of the curious.—*Mining Journal.*

*Sugar from Corn.*—A new mode of raising corn trebles the saccharine quality of the stalk, and with attention it is confidently expected that 1,000lbs. of sugar per acre may be obtained. Complete success has attended the experiments on this subject in Delaware, and leave no room to doubt the fact that if the stalk is permitted to mature, without suffering the ear to form, the saccharine matter (three times as great as in beets, and equal to cane) will amply repay the cost of manufacture into sugar. This plan has heretofore been suggested by German chemists, but the process had not been successfully introduced into the United States, until Mr. Webb's experiments at Wilmington the last season.—*Report to Congress of the American Commissioner of Patents.*

*Singular Discovery.*—A few days since, whilst two sawyers were engaged in cutting a log of rough elm timber, upwards of 3 feet in diameter, to make the gripe (a piece of wood that is fixed at the lower end of the stem, and fore part of the keel, and materially helps the ship to work to windward) for the *Albion*, 90 guns, building at this dock-yard, there were discovered five pieces of oak, about 2 inches thick by 4 inches wide, and each piece about 1 foot in length, lying in a direction towards the centre of the log; the pieces were closely and firmly united to the tree, and quite sound, and overgrown by the bark so as to render them entirely hid from sight.—*Plymouth Advertiser.*



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## SHANKS' GRASS-CUTTING AND ROLLING MACHINE.

Fig. 1.

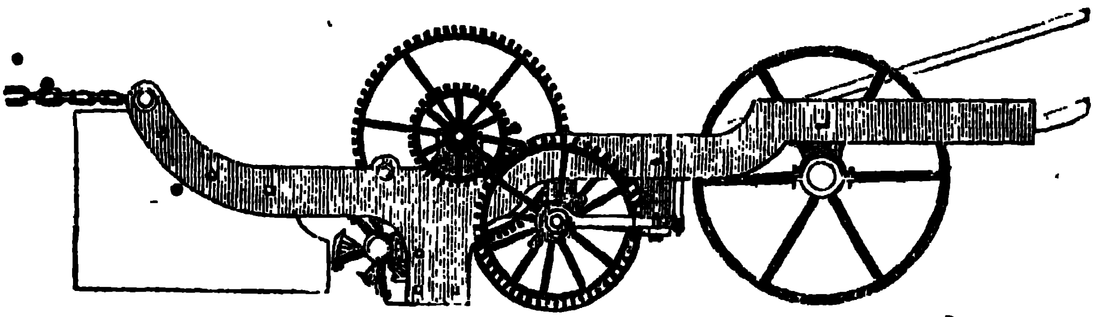
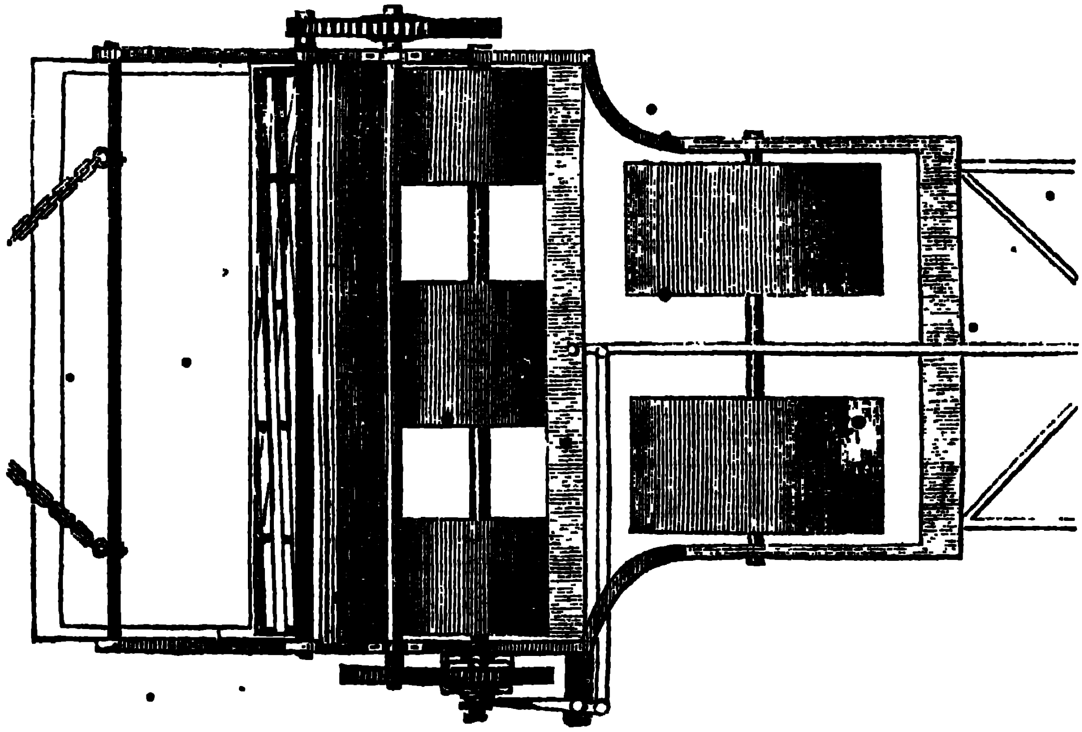


Fig. 2.



## SHANKS'S GRASS-CUTTING AND ROLLING MACHINE.

(Registered pursuant to Act of Parliament.)

We give, on the preceding page, engravings of the improved grass-cutting and rolling machine, invented by Mr. Alexander Shanks, jun., of Arbroath, and so highly commended for its performances by W. F. Lindsay Carnegie, Esq., in a paper by that gentleman which we lately extracted from a contemporary journal, (see our last vol., p. 400.) It is of the machine here represented that Mr. Carnegie says, "The new machine, which commands (a breadth of) 42 inches, has been just tested, and its success surpasses my expectations. The lawn of 2¼ acres is now cut, the grass swept up, and the ground effectually rolled by my gardener, assisted by the pony, *in two hours and a half;* and the execution, particularly where there is a good sward, leaves nothing to be desired. When the ground is much fogged, a surface is produced very similar to velvet." The machine, it will be observed, both cuts and rolls at one and the same time; while that of Budding (described in our 17th vol. p. 345) cuts only, and is too slight to accomplish any thing else. In Budding's machine, too, the cutting cylinder has to be guided by the hand, which is an operation of some delicacy, and requiring constant attention; while in this of Mr. Shanks' no guiding whatever is requisite, the cutting being effected by the mere movement of the machine in either direction. Again, the cutters in Budding's mower are fixed on a solid ring, which greatly impedes the cutting operation; but in Mr. Shanks' machine the cutters are attached to an armed wheel, in the manner particularly shown in the elevation, fig. 1, which enables them to make a much freer and cleaner sweep. Altogether, the present machine is evidently much superior to any thing of the sort which has been yet produced.

The proprietors of lawns and pleasure-grounds are greatly indebted to Mr. Carnegie for bringing under their notice so cheap and efficient a means of keeping them constantly in order; and to the pleasure which it must give Mr. Carnegie to have rendered gentlemen of his class so useful a service, we doubt not, he will soon have to add, the satisfaction of knowing, that his recommendation has been the means of procuring the ingenious inventor, as many orders as he can possibly execute.

## THEORY OF THE CAUSATION OF MAGNETIC PHENOMENA.

Sir,—The time which has elapsed since I expressed my intention of sending for insertion in your valuable Magazine, my *Theory of the Causation of Magnetic Phenomena*, (see *Mech Mag*, vol. xxxiv. p. 471) has afforded me many further opportunities of discovering, that the principles which I advocate, and which from time to time I shall feel much pleasure in handing to you with a view to their publication, are entitled to some degree of consideration, not only from exhibiting these phenomena in a point of view they have not hitherto been shown, but from their having been subjected to the scrutiny of some of the most eminent men in this branch of science, and their still remaining uncontroverted.

Through the medium of the *Mechanic's Magazine* this will meet with much publicity, and I trust that what I shall hereafter advance in reference to this important subject will lead to some inquiry from those of your numerous readers who are conversant with it, which may tend to place my views thereof in the position they may be found to merit. I shall feel much indebted to any one of them who may convict me of fallacy, and be happy to acknowledge my error.

Allow me to thank you for the honour of the insertion, and to remain,

Yours very respectfully,

G. V. Towler.

Norwich, June 4, 1842.

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It is my intention to show—

1st.—That the present adopted theory, viz., of *the two fluids*, is entirely unfounded and untenable.

2nd.—That magnetic phenomena are not due to any but purely *mechanical causes*, and that the positive and negative properties which are developed in these phenomena are the resultants of *quantities* and not of *qualities, or properties*, of fluid matter.

3d.—That they are in perfect accordance, and identical with electric, voltaic, and electro-magnectic phenomena, however produced.

4th.—That the fluid by which they are produced and carried on has no abstract occult existence in ferruginous or other bodies, but is derived from the atmosphere surrounding them, and is part and parcel of it.

5th.—That these phenomena are the results of a simple *motion* of the particles of matter, such motion being a stream, and are independent of any other agency.

6th.—That the positive and negative powers, whether magnetic, galvanic, or electric, are the inevitable consequences of a *stream* of fluid matter, the positive power being found at the point at which such fluid arrives, and the negative power at that which it vacates.

7th.—That the supernatant atmosphere is taken in, or absorbed by a magnet, on all sides of the negative half of a magnetic bar, and most largely so at its pole or extremity, and issues from all sides of the opposite or positive half, in the same ratio in which it enters. *Consequently, a magnet decreases the pre-existing quantity of matter in the space from which such fluid is derived, and augments the pre-existing quantity in that space into which it is emitted.* The immediate space around the positive magnetic pole becoming so much denser of fluid matter (than a corresponding space in the media beyond the influence of the magnetic action) as that surrounding the negative pole in the same space of time becomes rarer; *whereby two atmospheres are formed, both differing in density to the adjacent media.*

8th.—That magnetic motions are generated by, and depend upon some, or any exciting cause, or impetus which is adequate to destroy the equilibrium of the fluid particles, contained in the spaces between the essential particles of metallic and other substances.

9th.—That the continuation, degree of duration, and intensity of such motions, are due to the density of the body in and through which they take place; such protecting and modifying the motions of the internal particles of fluid matter, as regards the external atmospheric pressure, and preventing an equilibrium being formed between the two.

## ON EOLIAN, OR FREE-REED INSTRUMENTS OF MUSIC. BY MR. ALFRED SAVAGE.

Sir,—A considerable addition to the means of our enjoyment has been effected, within the last fifteen years, by the application to musical instruments of the fact, that when the passage of air through an aperture is regularly stopped or impeded with sufficient rapidity at equal intervals, the aërial undulations so produced become audible. Many instruments constructed on this principle have appeared during that period, under the names of eolophon, concertina, accordion, eolina, seraphine, and others. Now as I am of opinion that the principle is one which promises far greater things than have yet been achieved, although the degree of excellence which has been produced is far from generally known, it may not be uninteresting to your readers to follow me through a slight sketch of the history and construction of the principal varieties of these instruments, and an examination of the causes of the various qualities of their tones.

This class of instruments is technically termed "free-reeds," in contradistinction to the reed-pipes of organs, which are constructed like the mouth-piece of the clarionet; that is, in the latter, the reed or spring valve is wider than the aperture which it partially closes, while in the former the valve or reed is not so wide and is shorter than the aperture, so that it can vibrate *freely* through it—whence the name.

The earliest known musical instrument on this principle is called the Chinese organ, which has probably been in existence for two thousand years. The mode adopted of causing it to utter its sounds at the will of the performer, shows that people, on whom we have been too ready to retort the charge of barbarism, have been for ages, practically at least, acquainted with a very beautiful fact in the laws which govern the production of sympathetic sounds; for the performer, by stopping holes in the pipes connected with the reeds, causes them to become unisonous with the sounds produced by the vibrations of the reeds. And, as if to afford another proof that novelty is only the rediscovery of forgotten things, the Chinese formed the reeds out of the same material in which they vibrate, which is one of the greatest, if not the

very greatest improvement, which has been recently made in instruments of this kind.

During the latter part of the eighteenth and the earlier portion of the nineteenth centuries, several experiments were made in Germany, particularly an attempt to connect the reeds with a sounding-board or belly, and a free-reed was employed in the speaking machines constructed by Kempelen, Maelziel, and others; but I am not aware that any musical results were produced of general interest, and shall at once proceed to a notice of some of the experiments of the late Professor Robison, to whom we are indebted for the first practical suggestions for the construction of musical instruments on this principle.

For the purpose of determining the number of aërial pulsations by which a sound of given pitch is produced, the Professor caused a common stop-cock to revolve at a known rate in a tube through which air was passing, and he found the sound so produced so pleasing, particularly when the plug of the cock was filed away, so as never to shut more than two-thirds of the passage, that in his judgment it surpassed the finest female voice. Now this may be considered as the first type of the *eolophon*, and his next experiment completely anticipated one of the modern forms of the instrument, for he "caused a circular spring plate to vibrate through a hole made in another plate, which produced a very bold and mellow sound;" which is the *seraphine* in every essential particular, only that the spring valve or reed is more conveniently made in the form of a parallelogram, although it may be questionable if the original circular form does not afford the best quality of tone. Professor Robison also, in some degree anticipated Mr. Wheatstone's instrument, by applying a current of air to variously formed strings, causing first a gut string, and successively a varnished silk ribbon, a flat silver wire, and a piece of watch spring, supported at both ends, to vibrate in a narrow aperture between two air chambers; but he did not employ a sounding-board or belly in connexion with the strings.

About 1827 several persons in England and on the Continent, had their attention directed to the production of a musical instrument on this principle, but I believe nothing was effected which could be depended on for continued use except the eolophon of the late Mr. Day; at least that was the only instrument among upwards of a dozen exhibited at the Royal Institution about that time, which could be performed on. The writer first heard it shortly after, and was much struck with the superiority of its tones to those of a German instrument then in his possession. From that time to the present, this instrument, which has always been the best of its kind, and the seraphine which ranks next to it, although far behind in general utility, have been much in use; but until a comparatively recent period the seraphine was not capable of being used for the performance of very rapid music, as it does not speak so rapidly as the eolophon.

The *concertina* may be considered the first of these instruments, which was performed on in the same manner as the *accordion*, from which it differs chiefly in the more convenient disposition of the finger-keys. It is also much superior in tone; but its capabilities in this respect are not very severely tested, as its compass never extends far into the bass, and it is much easier to produce pleasing sounds in the treble than from the lower bass.

One of the principal varieties of the quality of tone in instruments of this kind arises from the scale, or in other terms, the size of the aperture of a sound of given pitch. If the aperture be very small, the tone is very reedy, weak, and disagreeable; a large aperture produces a much more powerful sound, of better quality. The accuracy with which the valve, or reed, fits its aperture, also considerably influences the tone. If the valve be fitted with great accuracy the tone is harsh, compared to that produced by a reed which has some more leakage; but the latter does not usually speak so quickly, and wastes more wind. The tone is also better in proportion to the stiffness of the reed, but it is difficult to make a very stiff reed speak quickly. It is obvious that if a given pressure of air be the moving force, it will cause a weak spring to vibrate sooner than a stiffer one. If very stiff reeds be used, great pressure of wind is necessary to cause them to speak rapidly, and this renders the quality of the tone less pleasing, unless they be made propor-

tionably larger, in which case it affords the most perfect imitation of the trumpet which has yet been produced—far exceeding the best trumpet stops in organs.

Another cause of variety in the quality of the tones consists in the different means employed to connect the reeds with the frames in which they vibrate. If they be constructed of separate pieces of metal from the frames, some jarring inevitably occurs, and being heard with the tone, renders it impure. It will be remembered by your philosophical readers that the particles of bodies are most probably not in contact; and it is probable those of two dissimilar bodies cannot, by any force we can exert, be made to approximate so closely as the atoms of a homogeneous body naturally do. The consequence is, that however tightly the reeds may be screwed to their frames, if they be made to vibrate strongly, they jar; and this is heard most disagreeably as we descend towards the lower part of the compass. Nor was this defect cured, although much mitigated, by Mr. Day's ingenious contrivance of bending the reeds employed for the bass notes. It has, however, been entirely overcome by the re-invention of the Chinese method of forming the reeds out of the same piece of material which also forms the frame through which they vibrate. This was the contrivance of Mr. Storer, and was a very natural result of the application of that knowledge which he derived from his former profession, viz., a steel-pen manufacturer, (steel pens are almost entirely formed by pressure,) to the construction of free-reed instruments —furnishing another proof, among the many we almost daily witness, of the practical advantages of an acquaintance with more than one branch of manufacture. The tone of the instruments constructed by Mr. Myers, in this manner, is so superior to that of any with reeds removable from their frames, as to leave comparatively little to be desired; and from the material employed they stand in tune better, and speak more rapidly, than any other instruments on this principle with which I am acquainted.

The material of which the reeds are constructed also influences the quality of tone, although not very greatly. They have been made of brass and similar alloys, of silver, and even of gold. The noble metals possess one advantage, viz., not becoming oxidated; but they are not sufficiently elastic, and to be stiff enough, require to be too heavy—the goodness of the tone depending greatly on the stiffness of the reed. A hardened steel reed of any given degree of stiffness is not half the weight of a silver, and perhaps not one-fourth the weight of a golden one. It is consequently put into a state of vibration much quicker than either, as it does not so much resist the force, viz., the pressure of air, which causes it to move. The instrument with steel reeds therefore speaks much quicker, and when the reeds are shut up inside a wind chest, they are extremely unlikely to become oxidated; besides, hardened steel is much less liable to oxidation than soft steel or brass. Metals, however, are by no means the only materials of which reeds may be constructed. A piece of cane or wood, or, indeed, any substance sufficiently elastic, will answer the purpose; but nothing stands in tune so well as hardened steel.

The force of wind with which the reeds are blown has considerable influence on the quality and power of the tone; and I believe it is a matter of much practical difficulty to find such a scale of size as will afford an uniform quality of tone throughout the compass, if the pressure of wind be the same; generally the high treble requires much more force of wind than the bass, and perhaps the most equal quality of tone might be produced by some contrivance which should afford a means of regulating the supply or emission of air to each individual reed in the compass of the instrument. A graduated pressure from two or three to about six or eight inches would, I think, be found most beneficial in a compass of six octaves, and one bellows would serve, if applied in the way proposed by Mr. Myers. This would combine the most rapid speaking of the treble with the best quality in the bass, from which I am convinced the best quality of tone is produced, when the pressure does not exceed that capable of balancing a column of water two or three inches in height; it is so smooth, indeed, as to be hardly distinguishable from the open diapason of the organ.

An announcement appeared some time

[illegible] that some person at Paris had applied a current of air to one of the strings of a piano to continue its vibrations The string, under these circumstances, may be considered as a reed or spring-valve of an instrument of the free-reed kind, only it is fixed at both ends instead of one only; but it still acts as a reed. A violin string might be made to do so likewise; and this arrangement appears to possess the advantages of combining the sounds which result from the alternate emission and stoppage of air with those resulting from the vibrations of a sounding board or belly, and if this can be effected, a considerable increase of power, and change of the quality of the tone may be expected. Such an instrument, like the sostinente piano, would possess the rapidity which is peculiar to instruments of percussion, the vibrations originally produced by the blow of the hammer being continued by the impulse of the issuing air on the string; but I apprehend the power of swelling the sounds by the pressure of the performer's finger, which is the great charm of such instruments as the harmonicon, the celestina, the claveol, the odephon, or the sostinente piano of Mr. Mott, could not by any contrivance be conferred on it. Might not, however, the effects resulting from a command over the pressure of the wind be made available by means of pedals, as it is in the eolophon, and other instruments of the same kind? But all such instruments must, like the organ, be inferior in expression to those whose sounds are caused or sustained by friction, directly or indirectly applied to their strings, or other vibrating parts.

I remain, Mr. Editor,

Yours, respectfully,

ALFRED SAVAGE.

16, Garlic Hill, July 1, 1842.

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### BLASTING OF ROCKS BY GALVANISM—APPLIED TO THE REDUCTION OF A WATER FALL ON THE NORTH ESK.

Sir,—I observe in your Magazine for last month, No. 983, some strictures on the account of Mr. Roberts' mode of "Galvanic Blasting," detailed in a preceding Number. Will you permit me to offer a few remarks on the subject?

"J. F. B." objects to sand-tamping as an error, and states that the effect of an explosion on a column of sand is very different from that of a blow; inasmuch as the explosion penetrates into the interstices, and by means of its action on the included air will blow out the sand with great ease. In this view, sand must be the very worst of all tamping stuff.

Now, I apprehend we have here a case of "Theory *versus* Practice," for, in reality, sand makes excellent tamping. There must therefore be some flaw in the theory. There can be no doubt of the *tendency* of the explosion to condense the interstitial air, or of the air, if thus condensed, to throw out the sand; just as would happen if it were mixed with gunpowder throughout. I question, however, if this *really* ever happens. In a column of fine sand, either *quite dry* or *thoroughly wet*, the particles lie so closely together that the interstices are very small; they are at the same time separated by surfaces, so innumerable, so varied in their direction, and offering so much resistance from friction to the passage of the air, that long before the effect of the explosion has reached the interstices, the surrounding rock is rent asunder.

In point of fact this is the case; sand *may*, for aught I know, be blown out, if placed in circumstances where it is impossible for any thing else to give way, but I have never found it so; the rock has always yielded in preference, even where masses of granite of many tons weight had to be torn off by the explosion.

Of the superiority of galvanic ignition to any kind of fuse there can be no question; the fuse does not *entirely* prevent waste by the vent-hole; it is inapplicable under water; and it does not permit the simultaneous firing of several charges. When blasting is required only occasionally, or very small charges are used, it may not be worth while, or economical to apply the galvanic discharge; but wherever blasting is constantly required, and charges of even moderate size, as in granite, whinstone, &c., it will be found highly economical. The expense is 4*d*. each charge for cartridge and wire discharged; while the saving of gunpowder, especially with simultaneous firing, will be from one-third to one half of what is usually employed.

I can speak of the galvanic discharge

with the more confidence, having recently had it constantly in use in blasting under water. The operation was the reduction of a waterfall on the North Esk, belonging to Lord Panmure, with the view of rendering it accessible to salmon. The work had previously been abandoned as impracticable and dangerous. By this means it has been speedily and safely accomplished. The apparatus used, differed from that recommended in Mr. Roberts' pamphlet, in the absence of cells in the battery, and of binding screws on the main conductor, which was insulated by common twine. These differences render the whole working so simple, that a workman may acquire a knowledge of it in a single day's practice, and, if properly made, the apparatus is not liable to go out of order.

I am, &c. &c.

JAMES T. WILSON.

Glasgow Mechanics' Institution,
July 9, 1842.

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ECONOMICAL APPLICATION OF STEAM POWER TO THE MOVEMENT OF WATER WHEELS, AT WHEAL UNY. BY CAPT. TREGASKIS.

[From a description of a model of the machinery employed at Wheal Uny, given in the Transactions of the Royal Cornwall Polytechnic Society—Ninth Annual Report.]

The model represents a large steam engine, pumping water to work water wheels, for various purposes, but chiefly for breaking and pulverizing rocks of tin stuff.

The water drawn up by the steam engine from the bottom to the top of Wheal Uny hill, forms two separate mill streams, and after turning all the wheels in its course, returns again to the engine shaft, through an adit at the bottom of the hill, and is again drawn up for the same purpose. The same water turns the same machinery an indefinite number of times, as long as the engine may continue at work; the waste and evaporation being supplied from the bottom of the mine. Thus one and the same steam-engine drains the mine of water, pumps up additional water from the adit, draws up all the stuff broken from the lode, breaks it down to a proper size for stamping mills, and these stamping mills pulverize the whole, in order to separate, cleanse, and make the ores merchantable.

The model represents machinery actually in use.

The steam-engine at Wheal Uny is represented by its type on the platform pumping water. The first wheel turned by the water, and which stands on the same platform with the steam engine, works a whim-engine for drawing stuff. The groove in this machine in which the chain is wound up, has a vertical position. The second wheel works another steam engine, which has the groove for winding up the chain in a horizontal position. The third wheel works a large hammer, for breaking down the large stones to a proper size for the stamping mills. All the other wheels work stamping mills to pulverize the ore.

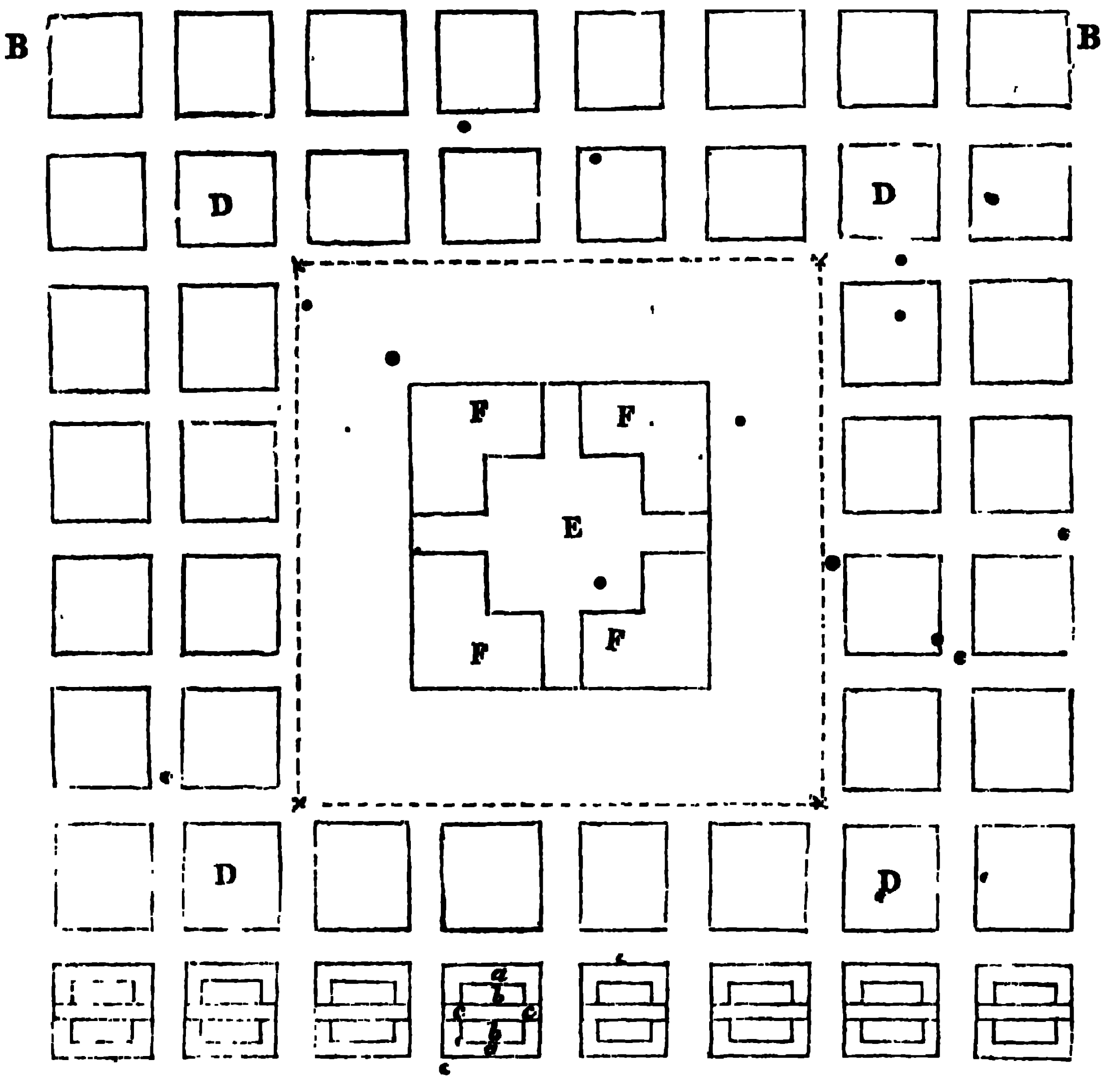
The model is intended to show the mode in which steam power may be applied, with advantage and economy, to stamping mills by water, as the medium of communication between the first mover and the stamping apparatus, instead of the crank. The mode of applying anti-friction wheels, under the large water wheels, in the simple manner in which they are fixed at Wheal Uny is also shown.

The application is new both in the mode of communicating steam power, and fixing anti-friction wheels under large water wheels for stamping mills.

The application of steam power to water wheels, was first employed in this manner as a substitute for the crank, at Wheal Vyvyan, by myself, under the patronage of Mr. Charles Fox.

It may be asked, What advantage is gained by the mode adopted at Wheal Uny? In reply to this I would say:—It is an acknowledged fact, that pumping engines do more work by the consumption of a bushel of coal, when unconnected with the crank, than it is possible to do in connexion with it. And we have found by experiment, that more work is performed by pumping water over wheels, than can be done by the steam engine through the medium of the crank, when connected either with the winding, or stamping apparatus. Wheal Uny engine, last month (July, 1841), pulverised fourteen sacks of very hard tin stuff through a fine grate, with a bushel of coals, each sack containing twelve gallons; this exceeded the best stamping engine in the county; very few steam stamping mills do as much as ten sacks, with a bushel of coals. Wheal Uny steam-engine lifted about seventy-six million pounds weight one foot high, by the consumption of one bushel of coal, through the whole of last month (July).

DESCRIPTION OF A GROUND-PLAN FOR TOWNS IN GENERAL, BUT ADAPTED PARTICULARLY TO THE RESTORATION OF THE CITY OF HAMBURGH; DESIGNED BY F. A. BERNHARDT, ESQ. ARCHITECT, LATE OF BERLIN, NOW OF LONDON.




The plan represented in the prefixed engraving was submitted to the Senate of Hamburgh, by the Consul-General, J. Colquhoun, Esq., on the 11th of June last, accompanied with the following explanatory description by the designer.

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I am convinced that if accidents by fire are to be avoided, in densely-populated cities and towns, and if the authorities of such places are really desirous that the inhabitants shall enjoy the full benefit of breathing an atmosphere as pure as possible, no other plan can be devised equally effective as the one now laid before you, for securing this twofold advantage.

In regard of economy and safety, every well-informed person will readily understand, that if instead of ten fires, only one were to be in operation, and that so constructed as to preclude the possibility of setting the chimney on fire, even by authority or incendiarism, then four-fifths at least of fuel would be saved, and the danger from fire diminished nine-tenths. It will further be clear, that if it should so happen that a fire were to occur from casualties unconnected with the fireplace, and if the inhabitants were so unfortunate as to make the greatest blunders in their attempt to extinguish it, not more than one square could possibly be damaged. Even this, however, would never happen to any very serious extent, as every house would constantly have at command, an abundant supply of water, sufficient to extinguish any fire that might occur, from whatever cause.

I believe that 180 squares, as B B, besides the large Exchange square E F, in

the centre, are more than requisite for the comfortable accommodation of the houseless families of Hamburgh. Ten houses of 18 feet each, *a a*, in front, will make 180 feet frontage on each side of a square, forming the streets. Each corner building will have two fronts suited to purposes requiring such a position. The extent of frontage of the houses may also be varied in accommodation to the necessities or convenience of the intended occupants of the buildings respectively. If the houses be 30 feet in depth, the interior square will be 120 feet. If we take 20 feet for the width of the road *c c*, to the warehouses *b b*, and 20 feet for kitchens or cellars, 10 feet on each side of the square, there remains on each side of the road to the warehouses, a space 40 feet wide, by 100 feet in length. If this space be divided into five equal parts, we find it might be occupied by 10 warehouses, 5 on each side of the road, 40 feet long and 20 wide.

The warehouses should be erected on the squares nearest the Elbe. I think they would also be best situate in the centre of the squares, on account of the nuisance to the public of loading and unloading in the public thoroughfares.

Other squares may have exhibition rooms, lecture rooms, school rooms, manufactories, counting-houses, shops, shambles, and all sorts of markets, stables, pleasure-grounds, or theatres of amusement, &c. &c.

Four pleasure squares, D D D D, should be merely enclosed with railings, without any erection or buildings.

All the interior squares should be covered with the flat roof, invented by me, in 1824, and which was used on the Royal Palace at Berlin, thirteen years ago, and has proved perfectly satisfactory. When the advantages of this superior flat roof are fully understood, and duly appreciated by a discerning public, there is no question it will entirely supersede all other roofing now in existence. It requires but little wood—it is therefore more economical than other roofs; and it is so simple in its structure, that every workman can place it. It can be transferred from one building to another, without the least damage to the plates, forming such roof.

If economy in fuel be of importance to the inhabitants, each house may be warmed by the kitchen fire alone. This I have several times proved in London. Every room, whatever its use, will be well ventilated by such continual change of air, both by day and by night, throughout the year, ensuring warmth in winter, and coolness in summer, without any machinery,—pots, pipes, bowls, &c. All fire-places constructed and erected in accordance with the principles of my new science in natural philosophy, will be entirely free from the usual defects; and no building can be endangered by the requisite apparatus.

Every manufactory, warehouse, stable, closet, drain, or other necessary openings, must have free ventilation (conducted without machinery or the use of fire, by the physical, chemical, and mechanical powers of nature) to prevent any noxious vapour from mixing with the air in the streets. These poisonous exhalations should be conveyed away without unsightly flues, &c. This my new and exceedingly useful invention will prove the best means for keeping the air always pure and wholesome, in towns of every description of buildings.

All buildings requiring light by night should be lighted up with gas, in accordance with the principles of my new science, so that not the least danger will exist of explosion in the buildings so lighted, agreeably to my English patent method of gas-lighting. The noxious vapour from the flame is not allowed to intermix with the atmosphere in the rooms, but conducted away into the open air, on the outside of the buildings. This light consumes 30 per cent. less gas than the gas lights in general use in London.

Should this my plan be adopted, I propose having two, or not exceeding four water cisterns erected in each square; the whole so arranged that every room shall have a water-cock, and the water-cisterns and pipes be secure against the most intense frost of the coldest winter.

The principal square, containing the Exchange, in the centre of the town, is proposed to be 400 feet on each side (if space will permit), and four buildings, F F F F, in the centre of this square, will occupy a space of 200 feet square, uniform in frontage, and 50 feet deep, leaving a central square of 100 feet for the Exchange, E. These buildings may have apartments suitable for a senate, courts of justice, consistory and university (if required), library, halls, concert rooms, ball rooms, &c. &c.

To the Exchange buildings, as also to

the Exchange itself, there will be four entrances, by means of a flight of steps situate in the centre of each front. The Exchange will have a skylight.

It is not easy for the public to judge between true and false science, as the community are so often deceived by men of science as well as by empirics in philosophy. I therefore think it my duty to subjoin a few of the very numerous unexceptionable testimonials I possess, from ministers of state and scientific men of exalted rank, in London and on the Continent.

F. A. BERNHARDT, &c. &c.

20, Crosby Hall Chambers,
Bishopsgate Street.

[Subjoined to the preceding statement are certificates from the Prussian Ministers, Schuckmann, Maltzahn and Schoning, the Prussian Ambassador Bulow, and several other subordinate functionaries of the Court of Berlin, all of a very favourable character; these are followed by others even more so, from Charles Barry, Esq., the Architect of the British Houses of Parliament; Joseph Hansom, Esq., the Architect of the Birmingham Town Hall; Dr. Nathaniel Grant, and Dr. A. Toulmin. Mr. Barry says, "From the experiments I have made and the evidence of others, I believe that any degree of warmth may at all times be obtained by means of the stoves which he (Mr. Bernhardt) has erected." Mr. Hansom thinks Mr. Bernhardt's "stove perfect," giving "a warm and salubrious air and acting as a perfect ventilator." Dr. Grant pronounces it "more likely than any other he has seen to produce the effect of keeping the air in a room wholesome." And Dr. Toulmin says, "the points of excellence are, that a house thus warmed, is constantly supplied in every part with a pure and warm atmosphere of any given temperature, whilst the air, vitiated from having been breathed, is constantly carried off, and thus a continual aërial circulation is established." These are strong testimonials; but the readers of the *Mechanics' Magazine* cannot be expected to have forgotten that it contained, some three or four years ago, others of a different description. We must refer in particular to an elaborate paper by Dr. Ure, which appeared in our 28th vol., p. 273, and to which we have never seen any satisfactory answer. We question much, however, whether Mr. Bernhardt's system has suffered so much at the hands of any person, as it has done at his own. His tone in speaking of it has been always one of extreme mystery. He is fond of referring, as he does, in the communication which we now publish, to "my new science in natural philosophy;" but he has never yet, to the best of our knowledge, stated plainly what "my new science" is. We have heard, that when asked to explain the *rationale* of his system to a Committee of the House of Commons, he declined, on the ground that that was his affair, not theirs! It is not by corking up one's mouth in this way, that patronage and support are to be obtained in this country; neither is this the way in which true science usually manifests itself. If there is really any thing good in Mr. Bernhardt's system—and it is difficult to believe that there are not some good points in what such men as Barry and Hansom have so decidedly approved—Mr. Bernhardt must enable the public, by a full and unreserved disclosure of particulars, to form their own judgment upon it, or make up his mind for the general neglect, which will be the inevitable, and then not unmerited, consequence. ED. M. M.]

## THE CRANK QUESTION.

Sir,—I did not see your correspondent "M.'s" first answer to my last letter till February, although it was in your October Part, and expecting shortly to proceed homewards I put off answering it until I should be on my return; this was delayed from various causes till April, when his December letter arrived, so I now sit down to answer both, hoping to be the bearer of my own letter.

It appears to me, that in his last letter, "M." has so completely annihilated his original experiment, and the *conclusions* he considered himself justified in drawing from it, that I need scarcely have noticed it again, had he not very coolly, a little further on in this same letter, told us, that his arguments were as sound as ever! I shall therefore endeavour to open his eyes to their true state. He tells us (vol. xxxv., p. 259), "The work performed in the experiment when 37½ lbs. was in motion, is represented by the number 149." And in his second letter, (page 470), he says that the 50 lbs. weight only moved 2·7, when the 37 lbs. moved 4 inches, and therefore, that "the power actually expended" in this case, "was $2{\cdot}7 \times 50 = 135$ only." In this experiment then, *as far as it went*, I presume your cor-

respondent will allow that there was no loss of power; his silence indeed on this head shows his inability to deny it. The fact that the 50 lbs. only moved 2·7 inches, proves, however, a great deal more than this, as it clearly shows that the leverage of the cross bar differed in the two different parts of his experiment: for when the 28 lbs. moved 4 inches, the 50 lbs. moved 2 inches, but when the 37 lbs. moved 2 inches, the 50 lbs. can have only moved 0·7 of an inch, so that in the first case, the leverage was as one to two; in the second, as 7 to 20, or as 1 to 3 nearly. Hence, if "M.'s" expectations had been verified, and the 37 lbs. weight had been moved 6 inches, the 50 lbs. weight would have only moved $2+0{\cdot}7\times2$ inches $=3{\cdot}4$ inches, and therefore, the power expended would have been only $50\times3{\cdot}4=170$; the same quantity of work would have been done as in the first instance, where 200 represented the power expended, and we should have had the power increased by the crank instead of being diminished. The same would have been the case, even if the 55 lbs. weight had been sufficient to draw the 37 lbs. 6 inches.

From these considerations, Sir, your correspondent will perceive, that in his future experimental career, he must be a little more careful in observing facts; lest he should innocently take for granted, the very thing he wants to prove, as he did in this case, where we see he never took the trouble to ascertain what *the power expended* really was! *supposing* that it was just what he expected it to be.

"M." seems inclined now to carry the war a little further into mechanics, and to attack some of its elementary principles, (considering the crank, of course, completely floored), for he tells us that, "although it is an elementary principle in mechanics, that increase of surface, the weight" *(pressure)* "remaining the same, will not cause increase of friction, nevertheless, such is not the case in these experiments. Now, in his experiment he certainly doubled the surface pressed; but the original pressure was not distributed over the whole surface thus increased, as is supposed in the above proposition; for the pressure on the lower side of the board continued precisely as it was before, and the additional surface sustained a pressure equal to that upon the lower side: whence it is evident, that the friction produced by this new surface, must have been equal to that *still* generated by the original surface, (supposing all the surfaces pressed to be alike), and therefore that the effect was just the same as if he had tied another board to the first, and loaded it with an equal weight; but was totally different from that which would have been produced, by *merely increasing the surface*—putting a larger board instead of the smaller, for instance.

So much for "M.'s" original experiment. He now, however, gives us a new one, to which he requests particular attention. Before I examine it I shall just state what I understand "M." to mean by the expression "loss of power in the crank:" for if we were to misunderstand each other on this point, there would be no end to the discussion; and I presume, Sir, you would not consider that "a consummation devoutly to be wished." By "loss of power," I take it for granted that he means an *irreparable* loss, consequent upon *the use of the crank:* a sort of *destruction of force* by it, when transferring the force from the piston to the machinery: otherwise it could not be rightly called *a loss*, and otherwise his experiments would have been utterly worthless, even in his own eyes. I must also take the liberty of reasserting and proving, that his apparatus does not at all represent a crank, except in the latter part of its action, after the bar comes against the stop; in the former part, the board is drawn by a constant force, acting upon it in a straight line for a definite time and distance; whereas, in the crank, the acting force is never constant for a moment, and never acts for any definite time in the same straight line, the motion being always rotary. Farther in his machine we may perceive, that the instant the bar touches the stop, the acting force it suddenly diminished to one-half, or less. Now, may I ask, in what part of a crank's course does this phenomenon take place? "M." very coolly tells us that he takes this sudden *drop*, from the force at 90° to that at 30°, to—*facilitate investigation!* But, to return to his experiment. He now destroys all the momentum by using a steel spring, instead of the weight *under* the table; and by preventing the weight *on* the table from being moved (see vol. xxxv., p. 260). In this state of things he finds that the 37 lbs. weight does not move beyond the stop at all, and accordingly, in his usual vague way, he tells us, that he considered this "quite conclusive," without saying what his conclusions are. Here then, (although I suppose, I shall, as usual, be charged with "misrepresenting"—because I attempt to interpret his half-expressed, ill-digested notions, and *that*, because, forsooth, I "find a difficulty in refuting them!") I shall conclude, he means, "quite conclusive" in proving the loss of power in the crank. He then defies any body to prove his "*facts* or his *reasoning* to be erroneous." The former I admit, as there is not the same room for

error in this experiment, as in the original one, and I do not question his veracity; (although he is civil enough to hint that he doubts mine): but as to the latter, I really can find *none*, in either of his last letters—so of course I have nothing tangible to question. Perhaps, however, he alludes to his old *statement*, (ushered in with a "consequently,") that "the 37 lbs. weight should move 6 inches if there was no loss of power in the crank," which he seems to consider sound and available for this experiment also; I must therefore reiterate, that it is utterly inconclusive; as I have already shown, and as is, indeed, nearly self-evident in many ways. For instance, it may as well be stated thus: "We have therefore $56 \times 2$ in. + $28 \times 4$ in. = 224" = $74 \cdot 6 \times 3$ in.; "a weight consequently," of $74\frac{6}{10}$ lbs. should be moved 3 inches; now this is just as legitimate a conclusion as "M.'s," but is manifestly an absurd one; for, by hypothesis, 56 lbs. is the *greatest* weight that can be moved by his apparatus. The true state of the case is, that 37 lbs. can be drawn 6 inches, or 74 lbs. 3 inches, by the power here expended, if a suitable apparatus be arranged; but to suppose that any machine which does not produce this full effect, is therefore to be thrown side as inefficient and *a destroyer of power* in all cases, would be scarcely less absurd, than if one was to object, that a smith's vice must necessarily be a useless inefficient instrument *in all cases*, because it has been found to be so, when applied to the operation of breaking stones for a Macadamised road, or of grinding corn, &c. Moreover, Sir, I think I might safely undertake, with the addition of another cross bar, (so as to suit it to the work to be performed,) to make your correspondent's own apparatus draw the 37 lbs. 6 inches, or even the 74 lbs. 3 inches, and thereby make it *reproduce* the *lost* power; but the description of this arrangement would be rather too complicated to insert here; besides, I dare say your correspondent will, himself, easily see how it may be done.

If "M." will turn to my first letter (page 389, vol. 34,) he will see that I there told him that the board with the 37lb. weight on it would not have moved beyond the line *gh*, but for the *accelerated velocity* produced by drawing it back two inches; and that this was the case, "M." seemed to allow in one of his last letters, (page 259,) when he says that it was the *increased momentum* which he expected would have carried the 37lb. 6 inches. Now in the experiment we are at present considering, he has confessedly destroyed all the momentum, and yet he blames the crank for not performing this work which in this same letter he tells us could be done by the momentum and it alone. I must therefore take the liberty of asking him *again*, "with great simplicity," as he says,—did he "expect an increase of power in the crank, in the latter part of its action, in the ratio 28 to 37, because in the former part," he "diminished its task in the ratio of 56 to 37?" And I hope he will give me a simple answer; he must, however, remember this time, that *momentum* is not to be brought forward in it. "M." seems anxious to know why there should be a difference with regard to the *work done*, in the two cases he gives, viz. with and without the cross bar; if he will try the following experiment, *and explain* it, he will find the explanation applicable to his own. Let his cross bar be removed altogether from the table, but the anti-momentum contrivance retained, and let the line be passed directly from the spring over the pulley to the board *k*: the spring is to be so arranged as to have only *two inches play*. We shall now suppose the 56lb. weight placed on the upper board, and the under one (*k*) drawn back *these* two inches; of course it will again be drawn this distance *by the spring*; then, (the board being again drawn back), let the 56lb. weight be replaced by the 37, and, (if all the momentum has been destroyed), we shall find that the board will still be only moved through the same space of two inches, and therefore that the same quantity of work will not be done; that performed in the first case being to that in the second as 112 to 74, or as 3 to 2: here he will have no crank upon which to throw the blame.

In my last I suggested an experiment of which "M." has taken no notice, but to object that it is a limited one; referring to what Smeaton says in a spirit of sound philosophy; viz. that he looks upon "experiments made on working models" to be "the best means of obtaining the outlines of mechanical science." Now may I ask "M." to tell me honestly, whether the plan of my apparatus, or of his, is most like a working model?—*a working crank!* and how his experiment is less limited than mine? The most general practical proof on the subject must include only *some single crank*, but at the same time we may observe, that any clear proof that there is no loss of power in *any one particular crank*, is to be considered as perfectly general for all others, for they can differ from each other only *in size*. For let us suppose the case of a crank, in the working of which there is no loss of power,—and "M." has allowed (vol. 34. page 265) the possibility of such a case, for he says "there may be little or no loss of power in the crank of a railway locomotive"—now if we alter the nature of the

work to be performed by it, would it not be absurd to suppose that there might be a loss, occasioned by *this very crank?* For this would imply, that the crank *now* stopped and appropriated a certain portion of the power which it formerly transferred, and applied with effect! If, therefore, "M." should at any time prove ever so clearly, any practical loss to exist in any engine or machine of his construction, he must look somewhere else than to the crank for the cause. But let him bear in mind that the unfitness of a machine to perform work, for which it is not adapted, is not to be taken as the proof of an irreparable loss. For instance, in the case of a steam engine working machinery without a flywheel, the varying nature of the force, which of course is owing to the crank, would undoubtedly cause a great inefficiency and *waste* of power; but as we know how to cure this sort of loss, we must, to describe it correctly, say it is owing to the want of a good flywheel, and not to the use of a crank: this is the sort of loss which "M." has fallen foul of, and which has so sadly puzzled him, and brought him into his "present troubles."

It is very easy, Sir, to sneer at the "blunders these mathematicians will make;" but, considering circumstances, I think I may fairly remind your correspondent of the old proverb, "those that live in glass houses should not throw stones." It is not however the mathematicians that make blunders, properly speaking, so much as the philosophers, who mingle mathematics and practice, not to discover the truth, but to carry out their own theories: nor are the blunders to be found in the mathematical parts of their calculations, but chiefly in the facts or *statements* with which as *data* they support those theories. It is then the *experimentalists* that are often the cause of error; they should therefore take peculiar care that they see clearly *all* the bearings of their experiments, and the *conclusiveness* of their arguments, before they found any theory on them, or bring them forward as controverting, long received principles.

I must now remark upon another mis-apprehension and misapplication of "M.'s" with regard to Dollond's (not Drummond's) well-known discovery of the achromatic lens. For Dollond "questioned" *no* "demonstrations of Sir Isaac Newton, that prince of mathematicians," as we are told he may justly be called, *considering the age in which he lived!!!* Of course if he lived now-a-days, he would be but a prince of *blunderers*, not fit to hold a candle to *some* of our experimentalists and practicians. The case was this: Sir Isaac Newton found by his discoveries that an achromatic lens would be procurable, if the relation between the dispersive and refractive powers should prove to be different, for different *media:* he accordingly tried the experiment between water and glass, and found the relation the same in each, and then unluckily gave up the hope of getting an achromatic lens, supposing that the same property obtained in all other media. Dollond fortunately questioned the correctness of this latter *supposition*, tried the experiment again, and found that his doubts were well grounded, and therefore that the achromatic lens *was* procurable. This however only showed that the glass and water Sir Isaac used (in which latter, I think, it is supposed he had dissolved some salts of lead, the refractive power of which was not then known) happened *accidentally* not to differ in their relative refractive and dispersive powers; but did not in the most distant way imply, that any of Sir Isaac's *demonstrations* were in the smallest degree incorrect, (as "M." would lead us to suppose) although they were arrived at with the assistance of that impotent science, mathematics.

Your Correspondent also shows the weakness of his side, by the analogy he attempts to strengthen it with; telling us, that we might as well attempt to give a formula for a daguerreotype sketch, or an electrotype deposit, as for the heating power of a boiler, *or for the action of a crank*, as exhibited in *his* experiments! Can anything, Sir, be more absurdly ridiculous than this? What connexion, analogy, relation, or similarity, is there between the crank (as much a mechanical power as the lever or the screw) and the actions of heat, light, or galvanism? In his next I suppose he will be defying us to settle mathematically the relation of the power to the weight in a lever of the first order.

My excuse, Sir, for trespassing at such a length upon your columns, on this subject, must be, that "M." seems to think his facts and statements "so perfectly conclusive, that really some of your unscientific readers might be misled by his confidence, and actually suppose that he had made out something of a case:" I repeat this from a former letter of mine, to correct an error in it, of which I forgot to send you a note at the time: "unscientific" was misprinted "scientific," whereas I assure you, Sir, I never intended for a moment, to libel your *scientific* readers, by supposing, that *they* could be puzzled or misled, by such facts or statements.

I am, Sir,

Your obedient Servant,

R. W. T.

## PURIFICATION OF THE WATER SUPPLY OF THE METROPOLIS.

Sir,—I have seen with the greatest satisfaction, in the *Sun* and other newspapers, mention made of the method of filtration, of which Mr. Stuckey is the inventor. I am heartily glad to see this matter at last taken up as it should be. I reside at Rotherhithe, and the water in our neighbourhood is dreadfully bad; people are obliged to boil it in order to destroy the flies and other insects with which it abounds, before it can be considered drinkable—it has a dirty look, and if put into a bottle there is speedily a deposit of mud at the bottom. If a large quantity is wanted for any purpose it must first be left to settle in large tubs—but water thus stagnant, and already mixed up with extraneous matter, some of which is already putrescent, will soon become really putrid, and unfit for use. I have had serious thoughts of changing my abode, in order to go to some other part of the town where the water is drinkable; I shall, however, now wait, and see if the invention is adopted, because, if it is, its *grateful* effects will be most *gratefully* received in all parts of London, and in none more than that where I am located.

Notwithstanding the large sums of money which have been expended on this object, it must be confessed that London does not shine in her water-works; the supply is plentiful, but in no instance whatever does it serve for ornament. Probably those who have the management of such things, are well aware that our London fountains would not pour fourth very *silvery streams*—consequently, they very wisely keep all their works under ground; though with half the money which has been expended we might have had aqueducts which would have vied with those of ancient Rome, and been an ornament to the country.

I am, dear Sir,

Your very humble servant,

SAMUEL JEFFERSON.

Rotherhithe, Princes-street,
July 13, 1842.

## THE ATMOSPHERIC MARINE ENGINE.

Sir,—Your 985th Number contains a description of a marine engine upon a new plan, which has recently been applied by Messrs. Seaward and Co. to a steam vessel. It appears to me that this is a step in a retrograde direction, inasmuch as one of Watt's grand improvements, the substitution of the pressure of the steam for that of the atmosphere, is thrown aside to return to the exploded atmospheric engine. In the new arrangement there are three open topped cylinders placed in a line athwart the vessel, and the three pistons are connected by oscillating rods directly to three cranks, forming angles with each other; which angles, it is to be presumed, are all equal, or 120° each. Now let us compare these engines with one of the many constructions now in use, say for instance the "Gorgon" engines, by the same makers. By the new arrangement we get rid of the weight, cost, and complexity of the cylinder-covers, piston-rods, and stuffing-boxes; a greater length of stroke can be obtained in a vessel of given depth, and the power of the engines throughout the stroke is more nearly equalised; but on the other hand we have three cylinders instead of two, and as the power of the engines in each case will be as the quantity of steam consumed by them in each revolution of the wheels, the area of the piston of the atmospheric engines must be to that of the "Gorgon" engines as 4 to 3, so that supposing the cylinders of a pair of "Gorgon" engines to be 50 inches diameter, the three cylinders of the atmospheric engine, to be of the same power, must each be of 57½ inches diameter. There must likewise be three slide-valves instead of two; the intermediate shaft, too, must be cranked, and there is a double packing to each piston, and a guide-rod working in a stuffing-box. On a full comparison, therefore, of these different circumstances, I apprehend that the atmospheric engines will be found to be heavier, more costly, and not more simple than the "Gorgon" engines, while the former, at the same time occupy more room. With regard to the greater length of stroke which may be obtained, many persons, and amongst them Mr. John Seaward, are of opinion that no material advantage is thereby gained. The comparison, therefore, is, I think, rather to the disadvantage of the new plan, and the only point in which it can claim an indisputable superiority, is in the greater equalization of the power of the steam exerted upon the crank. Against this, however, there remain to be set two great disadvantages, either of which would, in my opinion, more than counterbalance the admitted advantage. The first is the loss of heat which the cylinders undergo from their interior being exposed to the atmosphere during one half of each stroke, whereby a considerable quantity of steam must be condensed without producing any mechanical effect. The second is, that whatever may be the pressure in the boiler, the pressure upon the piston during the effective stroke cannot exceed the pressure of the atmosphere. Thus in the account of these engines given by you, it appears that the pressure of the steam was 8lbs., which, adding, for the 14lbs. for the

pressure of the atmosphere, gives a total pressure of 22lbs., whilst the pressure on the piston is only 14lbs.

Requesting to be set right by any of your readers who may detect any error in the above reasoning, I remain, Sir,

Your obedient servant,

M. J.

June 27, 1842.

THE ATMOSPHERIC MARINE ENGINE.

Sir,—May I trouble you with the following remarks, which, coming from one who is in no way connected with engineering, directly or indirectly, may be looked upon as arising from no interested motive? They have reference to the atmospheric engines placed on board their new river steamer by the respectable firm of Seaward and Co.

It has always been considered as of the greatest moment that, in steam-engines, the loss of heat by radiation or otherwise, should be as little as possible, both as to economy, and also as a matter of comfort to the engineers and stokers. Boilers and steam-pipes are felted, cylinders are surrounded by wood, and even charcoal, as a highly non-conducting substance, has been frequently employed. Every cubic inch of heated air arising in an engine-room is considered as a loss.

Having then been taught this by the most eminent engineers, what are we to think of an engine which every hour during its work, inspires upwards of *two hundred thousand cubic feet of cold air*, and after warming it, vomits it forth again in the expanded form of about *two hundred and fifty thousand cubic feet of heated* air—for an expansion of one-fourth is a moderate calculation? Are we to consider this as a legitimate use of coals? Is it necessary that a few tons of this expensive material should be burned occasionally for the sole purpose of *heating the engine room*, and distressing, by the suffocating and tallowy effluvia, the engineers already sufficiently heated by this high summer temperature? I think most engineers will pause before they give an answer in the affirmative. They will say, on the contrary, that there is an enormous and wasteful expenditure of heat and comfort.*

However, I am sure it would be interesting to your readers to know the actual consumption of coals in the atmospheric plan per horse-power, and also the temperature of the engine-room. *If* these are not very great—great virtue in that *if*—then only we may have some hopes of its success.

I remain, sir, your obedient servant,

W.

Blackwall, July 4.

* Three cylinders 47 inches, each of 3 feet stroke—pistons making 34 strokes per minute.

MR. VALLANCE'S PLAN FOR NAVIGATING THE NIGER IN SAFETY, OR OF CONSTANTLY MAINTAINING A SALUBRIOUS ATMOSPHERE ON BOARD OF SHIPS IN HOT CLIMATES.

16, Brook-street, West-square.
19th July, 1842.

Sir,—The erroneous view which Colonel Macerone's letter, in last week's Number of your Magazine, gives of one of two plans of mine, rendering a rectification necessary, I have to solicit the favour of your giving publicity to the accompanying letter relating to the last subject mentioned by the gallant colonel.

The method of producing ice, and consequently "cold," therein referred to, is not "by the ministration of carbonic acid gas;" and its object is to make ships in hot climates salubrious rather than "delightfully cool."

I have the honour to be, Sir,

Your most obedient servant.

JOHN VALLANCE.

*Letter to Captain Trotter, R.N.*

16, Brook-street, West-square.
16th June, 1842.

Sir,—A letter which I have received from Mr. Buxton recommending that I should address you, causes me to solicit the favour of your attention on a subject which may, possibly, prove not utterly unimportant in preserving health, and saving life, during the purposed ascent of the river Niger, by the expedition which is to be under your command.

You are aware that the Americans annually send cargoes of ice from Boston to Calcutta. The proofs given by these vessels make it known, that the caloric rendered latent by the liquefaction of about a hundred weight of ice per hour, is sufficient to keep a place containing 200 tons of ice—and equal, consequently, in cubical capacity, to a room 60 feet long, by 19 feet wide, by 7 feet high—cool, even when those ships are "crossing the line."

It follows that if (allowing me to use such an idiom) the expenditure of the "cold" produced by a hundred weight of ice per hour, will keep the holds of these vessels cool on the equator, your ships may be kept so on the Niger, provided we can furnish them with means of (again using an *à propos*, though incorrect expression) creating "cold" to a sufficient degree.

The object of my addressing you is to submit that we can (once more conveying a meaning, by using an incorrect idiom) create "cold" to any extent which you may require.

Above 20 years ago I discovered a prin-

ciple, and published a mode of operation, with respect to which—adverting not to intermediate, because they are less directly applicable publications—six years ago I wrote a paper, the following four paragraphs of which, I must request you to do me the favour of reading:—

But it is not on land only that an icing apparatus would be advantageous. Since as ice could be made at sea as well as on shore, (a capability which, by the way, will, eventually, prove important to our fisheries)* while an icing apparatus large enough to ice wines, lemonades, or other beverages for the passengers of any packet, or Indiaman; or wines, &c. for the officers, and grog for the crew of any man of war, could be supplied for a moderate sum, not only might voyages be, in consequence, made sources of profit, but also might passengers and officers partake the luxury, and the whole crews of our men of war in hot climates receive the strengthening and invigorating benefit of having their grog, (and all other beverages, including the very water they drink) iced; a circumstance which would be important, not only medically speaking, and as an auxiliary to the surgeon's care in many cases of tropical fever, but *(in degree)* even nationally speaking; from the way in which it would strengthen the men, and add to their physical powers, in cases where extreme heat half incapacitates them for bodily exertion; as well as from the degree to which it would serve as a febrifuge under attacks of disease.

There are, indeed, occasions, on which it is possible that this method of counteracting the weakness which torrid zone temperatures produce on our sailors, might prove auxiliary, even to the honour of our flag.

Lord Rodney's victory; that of the Nile; the hard-fought action of Algiers; and others of our glorious naval triumphs, have been gained in hot climates. Now could our sailors, on those occasions for extraordinary exertion, have had part of that native vigour of which the heat of the climate deprived them restored, in consequence of the water which they are allowed to drink during action being, not actually iced (because that might be too cold for men who are *excessively* heated to drink hearty and *hasty* draughts of), but made so refreshingly cold as to "smack" on the palate, and invigorate the frame, there can be no doubt that their bodies would have been capable of going through harder work, and their spirits equally disposed to work harder.

And as this invigorating refreshment could easily be given, by icing a number of butts of water during the chase, to be mixed with the other *sickeningly warm* water, and served out during the action, it would be equally in a captain's power *thus* to strengthen the bodies and heighten the spirits of his men, as it is to order an extra glass of grog to be served out, on those occasions when harder duty renders it necessary.

Two years ago, I wrote the following paragraph:—

Seventhly. The ship, instead of being hot as steam vessels are, shall be "cool as a cucumber;" while she should possess the advantage of being, throughout all tropical regions, capable of supplying ice, not only to cool beverages, but also to cool cabins and berths; so as, in degree, to carry the climate of the temperate zones into, and throughout the torrid zone: a capability which will prove not only a luxury to passengers, but so important a medicinal restorative to the crews of men of war in many cases of tropical disease, as might prevent unmannings of blockading fleets such as, after carrying off 3000 of his ships' crews, broke Admiral Hosier's heart. Indeed, it would require but a small portion of the engine's power and a cooling apparatus, to maintain an atmosphere low as that of the temperate zones throughout the ship; even were she *stationed* in the torrid zone.

As I placed the brochure out of which I have cut the last paragraph, in the hands of not a few persons two years ago; as I had largely distributed the paper from which the preceding four printed paragraphs are taken, during those six years; and as other observations which I am guilty of, involving the principle, have been before the public for twenty years, I presumed, until the appearance of the Parliamentary paper "179—V" of the present Session, that means would be taken to supply the crews of the ships which are to compose the expedition that you are appointed to command, with a cooled and dried medium of respiration, instead of leaving them to breathe the atmosphere of the Niger, in its naturally hot and humid state.

But as that paper made evident that though 600*l.* were to be expended in merely forcing air in its natural condition into different parts of the ships, even the idea of making that air cooler or drier than the hot and humid, atmosphere of the Niger affords, had not been entertained, I became desirous to submit to Mr. Buxton—as the individual whom public opinion considered to be the originator of the expedition—that it is in our power to furnish vessels on the Niger with means of supplying themselves with 10,000, 15,000 or 20,000 gallons of air per mi-

* Especially to our Newfoundland cod fisheries—as those fish could be brought to us in their fresh state, for less than it costs to split, salt, barrel, and get them hither, in the state we now receive them.

nute, cooled from the high natural temperature of those latitudes, to 50° or 60°; and so far desiccated as to deprive it of that excess of moisture with which the air of Western Africa is loaded; and thereby make it as cool and dry as may be desirable for the preservation of health and life.

But Mr. Buxton's absence on the Continent interposed obstacles which prevented me from obtaining his attention until now; when his recommendation makes it a duty to submit to you, that I believe it can be shown that ships in any part of the torrid zone may be kept as cool as the holds of the American ice vessels on the equator; their "between decks" being supplied with ten or twenty thousand gallons of air per minute, cooled and dried as above mentioned; and their crews with whatever quantity (suppose two gallons per man per diem) of iced beverages, the heat of the climate may dispose them to drink.

Could *carte blanche* be given with respect to time for preparing, and room on board for fixing the apparatus for these purposes, I would not hesitate to commit myself in regard to its efficiency. But considering circumstances which have offered themselves to my reflection since my letter to Mr. Buxton, I submit as follows with reference to time, space, and expense.

Should the same ratio of mortality take place with respect to your crews, as obtained on board the Quorra and Alburkah during Mr. Laird's attempt to explore the Niger, 129 of the 155 Englishmen you take out will be carried off by the climate; without reference to the smaller (though still *great*) mortality which prevailed among the Kroomen on board those vessels.*

Whether the public would consider any expense (that was not *enormous*) which might prevent this, to be objectionable, it is not for me to suppose. But as you will, probably, have to remain on the Niger (or its tributaries) throughout one, if not more wet seasons, and as, without a preventive, there is too much reason to fear that *many* of your men will, in consequence, fall victims to the climate, it may, perhaps, be permitted me to ask, whether space could be devoted to any better purpose than to containing such means of prevention; and whether expedition which denied time for their application, might not prove to be making more haste than good speed, with respect not only to loss of life, but, possibly, to that of the object of the expedition, from a cause other than that which may arise from want of "hands."

The idea may prove as erroneous, as its enunciation will be presumptuous: but I feel it, nevertheless, incumbent on me to submit, that you may perceive it natural to one who believes that a cool, and *dry* atmosphere can be insured on board your vessels throughout the wet season; and who sees no insuperable impediment to your crews being provided with dry exercising space during that period, by your decks being sheltered from the torrents of rain by a tarred sail-cloth or caoutchoucked canvass roof, capable of quickly rolling *itself* up, so as not to be blown away by hurricanes—you may perceive it natural that one who sees nothing insuperable in these things, should also be struck by the idea that, supposing the extent of the inundation in the lower parts of the country did not prevent the channel of the river from being discovered and kept, and also supposing that there should not be other insuperable obstacles which his ignorance renders him not aware of, the vastly greater depth of water during the wet season would allow you to pass rapidly over shoals where the Quorra and Alburkah were detained for, if I remember right, weeks at a time; and enable you to ascend, no one can tell how much higher.

Submitting myself to your censure by venturing to enunciate this idea, I conclude the prolix statement which Mr. Buxton's letter has caused me to intrude on you.

I have the honour to be, Sir,
Your most obedient servant,
JOHN VALLANCE.

* The actual result of the Niger Expedition has, we believe, been even worse than this. So much for taking counsel only of the science which is dressed in a brief authority.—ED. M. M.



## AMERICAN MARINE STEAM-ENGINE BUILDING.

The *New York Herald* publishes the following letter in reply to our strictures on the construction of the *Kamtschatka* steam frigate (vol. xxxvi. p. 222,) built at New York for the Russian government, with a recommendatory introduction of it by the Editor to the attention of his "commercial and scientific readers."

*To the Editor of the "New York Herald."*

In a recent number of your paper I noticed an extract from the *London Mechanics' Magazine*, relating to the steam ship *Kamtschatka*, which was built for the Russian government, by the Messrs. Schuylers of this city, with an implied invitation to the engineers of this county, to vindicate their reputation from the disgrace which the reputed failure of that ship was likely to bring upon them in that country and elsewhere.

Now, I believe, there are few who were acquainted with the circumstances under which the *Kamtschatka* was constructed, will attribute her faults to the want of skill or knowledge of American engineers generally. There are few indeed who were ignorant of the fact that, so far as the engines and boilers were concerned, it was professedly an experiment, and that it would not succeed was almost universally believed among practical engineers. The engines, no doubt, were inconvenient and ponderous, and the boilers inefficient and complicated—and suppose they were so, if the Emperor Nicholas desired it, and was willing to pay Jonathan for the labour, who is to find fault? Surely John Bull need not. He may wish to make a little capital out of its unsuccessful issue for the benefit of British trade. It does not look well in his eye, to see other than British steamers splashing in the big pond, even though they do so by the way of experiment! No, it is decidedly anti-British and dangerous in its tendency. It is, no doubt, something else which excites the rabidity of John Bull upon the subject of American ship building and steam navigation. It is not the failure of an experiment, but a kind of fearful consciousness that the resources of America and the developement of American skill will not become tributary to British vanity and wealth. The truth is, there is some evidence of the ability of Americans to compete with the best foreign builders and engineers, if not to establish their superiority over them.

We submit the following extract of a letter to a house in this city, in relation to vessels built in this city, for a foreign government, a short time previous to the completion of the *Kamtschatka*. Let the practical good sense of American workmen be displayed, free from the restraints and control of theoretical schemers, and the mist will be dispelled which now too much obscures the practical worth of American builders.

An important fact we might mention, in regard to British and American steamers is, that the Sirius, the only foreign steam-ship of about the same tonnage, which has resisted (revisited ?) our shores, did not perform, within twenty-five per cent. of the distance per twenty-four hours, which was accomplished by the Regent; while the relative nominal power was as 320 horses to 140—a fact that can only be accounted for from the intrinsic superiority of the American engine.

Havana, March, 1, 1842

Dear Sir,—

I wrote you a few days since from New Orleans, informing you of my intention to visit this place. I took passage in the steamship Natchez, Captain Swiler, and had a fine run of three days; the Natchez has been quite successful on this route—Captain S. is an able and attentive commander; few men could at this time take his place in the confidence of the travelling public.

I was much pleased on my arrival with the appearance of the two New York built steamers lying at anchor in this harbour, and as I had never seen them before, determined to take the earliest opportunity of visiting them, and confess my national vanity was somewhat excited by the enthusiastic encomiums bestowed upon the skill and integrity of our countrymen by Commodore De Llanes and the commanders of the ships, which are now called the Regent and Congress. All speak in the highest terms of the performance of the machinery, and those persons who have seen the British and Spanish steamers here allow that the premium must be awarded to the latter by a great majority, and the officers of the British steamers say they are not to be beat; for cleanliness they are unsurpassed. The engines have gained much credit and are highly esteemed; to Mr. Vandewater, 1st engineer of the Regent, I am indebted for a copy of the log of that ship on her recent passage from Cuba, which is subjoined; it will be of some use to those who feel an interest in commercial matters; the appended remarks are his. [The Log referred to is given on our next page.]

We are glad to learn from the preceding extract, that so far as concerns the construction of the engines of the *Kamtschatka*—which includes every thing material said by us on the subject—the Americans themselves admit that our strictures were perfectly just; "*the engines no doubt were inconvenient and ponderous, and the boiler inefficient and complicated.*" Now that these rather serious defects have been pointed out on this side of the "big pond," all the world on the other side sees and confesses them! Nay, they would even have us to believe, that nothing else than failure was ever anticipated by "the majority" of their "practical engineers." If this be true, we can only say it is rather surprising that none of the said majority ever took any means to make his misgivings public. At the time of the departure of the *Kamtschatka* for Europe, nothing was to be met with in the American papers on the subject of this vessel but the most extravagant encomiums on her construction and equipment in every particular. We are further told that she was "professedly an ex-

LOG OF THE VOYAGE FROM CUBA TO HAVANA BY THE STEAMSHIP REGENT, HAVING ON BOARD 300 SOLDIERS.

FRIDAY, 18TH DECEMBER, 1841, 5H. A.M. LIGHTED FIRES, GOT STEAM UP, AND STARTED AT 8H. A.M., ALL GOING ON WELL.

| DAYS. | WIND. | COURSE. | KNOTS. | REVOLU. PER DAY. | SAIL. | WAVE. | STEAM GAUGE | VACUUM GAUGE | EXP'N.VALVE CUT OFF AT | BOILERS. | LATITUDE | LONGITUDE. CADIZ. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| In 4 hours | N. light | W. by S. | 36 | 5,040 | Jibs, fore and main spencers. | smooth | 7½ | 26° | 3-8 | 2 | 19 48 N. | 70 39 W. |
| 18 | N. fresh | W. N. W. | 285 | 32,760 | Jibs, fore & main spencers & foresail | short & high | 7½ | 26½ | 3-8 | 2 | 20 43 N. | 73 51 W. |
| 19 | N. fresh | N. 85° W. | 205 | 26,820 | Top foresail and foresail 12 hours. | do. do. | 4¾ | 26 | 3-8 | 2 | 21 11 N. | 77 09 W. |
| 20 | E. light | W. N. W. | 181 | 25,800 | Jib, fore and main spencer 6 do. | moderate. | 5¾ | 27 | 3-8 | 2 | 22 04 | 78 40 W. |
| 21st in 23 hrs. | E. light | E. N. E. | 167 | 26,540 | None set. | long & heavy | 9¾ | 26½ | 3-8 | 2 | 23 47 | 76 06 W. |

The 21st, at 11h. A.M., entered the port of Havana. Amount of the knots run from Cuba to Havana, 824, in 4 days and 3 hours; speed per day 201 knots; do. per hour 8 knots and 3 fathoms, or 9¼ miles. We commenced this voyage with 86 tons of coal, and used 77—remaining 9 tons.

I am proud to say, the engines performed admirably well. We had no occasion to stop for any purpose on the whole voyage; and they were in as good condition on arrival in Havana as when we left Cuba. We discharged water from the boilers each fifteen minutes, and on examination after our arrival found no sediment had accumulated in them.—And finally, all that I can say about the engines and boilers is, that they are in as good condition as the day we left New York, and the Government have not expended a dollar for repairs of any kind whatever.

periment," of which the worst that can be said is, that like innumerable other experiments, it has failed. We feel a great curiosity to know when and where this was professed. Perhaps our New York contemporary may be able to enlighten us on this point. We remember to have seen her described, over and over, as quite a crack specimen of American ingenuity and skill; but there is not a trace on our memories of a single syllable about "experiment," or any thing of the sort.

Well—"suppose they were so"—continues our American respondent—that is, suppose the "*engines were inconvenient and ponderous, and the boilers inefficient and complicated*"—"if the Emperor Nicholas desired it, and was willing to pay Jonathan for the labour, who is to find fault with it?—surely John Bull need not!" We ought not perhaps to feel surprised at the sentiment conveyed by these words, after the arguments with which the American press has recently made us familiar, in favour of literary piracy and State-debt repudiation; but we must nevertheless express our regret at the low state of public feeling, of which all these things are such sad indications. It is out of the question, of course, to suppose that "the emperor Nicholas *desired*" to have such wretched engines and boilers, or that he bargained for any thing else than the best that America could produce. Moreover, the price he paid well entitled him to the best, for it was much higher than he would have paid for engines and boilers of the same contract power and capacity by the first-rate English makers. John Bull's right to find fault with the badness of the articles may be said to be founded simply on the interest which all men have in exposing dishonesty and imposture; for, as we have seen somewhere well remarked, a rogue does not cheat all the world *only because he cannot*. But if we are not greatly misinformed, the Emperor Nicholas has expressed himself quite as indignantly on the subject of this *Kamtschatka* job as ever John Bull has done.

The jealous motives imputed to us for the part we have taken in the matter are simply ridiculous. The engineers of England need not, and we feel well assured, do not fear any rivalry whatever; but were the case otherwise, there is no foreign body of Engineers, by

whom it would grieve them less to be eclipsed, than their Transatlantic brethren, for whom at all times they have evinced only the most respectful and friendly feelings.

With respect to the vessels (the *Regent* and *Congress*) built for the Spanish government, we have already (see our last vol., p. 417,) done justice to their merits, (with quite as much readiness too, as we found fault with the *Kamtschatka*, and with a great deal more pleasure,) and we are happy to find our anticipations of the performance of their engines, so strongly confirmed, as they are by the log of the *Regent*, now supplied by our American contemporary. The names of the makers of these engines are not mentioned by their own countryman, but delighting to honour all to whom honour is due, we think it right to repeat here that they were manufactured by Messrs. Ward, Stillman, and Co., of New York; from whom they lead us to expect things still more on a par with the productions of our English workshops. A few such matter-of-fact affairs as the log we now publish, will do more for the credit of American engineering, than whole volumes of such gasconading ribaldry, as the epistolary Jonathanisms by which it is here accompanied.

## THE SILLOMETER, DERIVOMETER, SUBMARINE THERMOMETER, AND STEAM-ENGINE INDICATOR, OF M. CLEMENT.

1. The *Sillometer* is the title given to a substitute for the common log, which has been recently invented by a M. Clement, of Rochfort, and is so well thought of by the French Admiralty, that it has been ordered to be forthwith supplied to the different ships of the Royal Navy of France. It is a most ingeniously constructed instrument, and promises to be of great practical utility. To describe it as well as we can in words:—

A hollow copper ball, against which the water acts, is attached to a moveable plug of the same metal, which slides in a copper tube that passes through the centre of the vessel to the keel; to this plug is attached a lever, which, by means of a vertical rod, acts on a second lever placed on the deck of the vessel, and communicating with a spring; the tension of the spring constitutes an equilibrium with the pressure of the water on the ball, and serves to measure the rate at which the ship is moving, by means of a hand, the movements of which on a graduated dial, indicate, at every moment, not only the speed of the ship, but also the distance run in any given time. A table annexed to the instrument allows the officer of the watch to note the distance traversed at the moment when he is relieved from his watch. The Sillometer resolves many problems of great importance. It gives every moment the rate of the ship's sailing, and also the space traversed in any given time. It indicates positively either the influence of a sail furled or unfurled, of a change in the placing of the ballast or of the guns, and what is the most favourable direction of the wind for its action on the sails,—a matter of great importance, whether in giving or receiving chase. It offers, also, the advantage of measuring, when at anchor, the force of currents on the keel.

2. Another invention of M. Clement's, which he calls a *Derivometer*, is an instrument to ascertain a ship's leeway. It is moved by a paddle, that may be placed under the keel at will, and is supported by a plug sliding in a tube like that of the Sillometer, but turning with the paddle and the rod. The motion is transmitted from the paddle and rod to two semi-circular dials, one of which indicates the leeway to larboard, the other to starboard. When at anchor, the instrument will show clearly the direction of the currents.

3. A third invention of the same gentleman, is a Submarine Thermometer. It appears from the thermometrical observations of many scientific navigators, that in seas of unfathomable depth, the water is not so cold as over banks, and that over banks near the shore it is less cold than over those at a greater distance, but colder than in the open sea.* M.

* The following is an extract on this subject from "Le Guide du Navigateur dans l'Ocean Atlantique:"—

"Water is much colder over shoals than in the open sea; the shallower the water, the colder it is.

"Water is colder over large than small shoals.

"Water over shoals near the coast is warmer than over those at a distance from it, but still colder than the water of the open sea.

"Water is colder over shoals in immediate proximity with the coast, than over those which are separated by a deep channel.

"The preceding rules are not applicable to water inside of capes or in rivers; less agitated, more exposed to the action of the sun, and in intimate communication with the earth, it is hotter or colder than that out of soundings, according to the season of the year, and the temperature of the atmosphere."

Clement's thermometer is kept constantly under water at the same depth, and indicates the different temperatures of the water by means of a dial placed on the deck of the vessel, and always open to examination. The immediate action is communicated by wheels, the working of which turns two hands upon the dial, the one marking the single degrees, and the other the tens. The whole is enclosed in a tube attached to the side of the vessel, and the helix of the apparatus is at the lowest part of the tube, in immediate contact with the water, and always at the same height.

In experiments which have been made on the coast of France with this Submarine Thermometer, results have been obtained which fully establish the great service this instrument may render to navigation, by furnishing a sure and constant indicator of all sudden changes from deep to shallow water. It is obvious that it will serve also to announce with equal certainty the approach of those ice-bergs, which at certain seasons of the year render the navigation of the Atlantic so perilous. The Editor of the "New York Herald," in lately attempting to account for the preference still given by the majority of trans-atlantic passengers to the old sailing liners over the modern steamers, ascribes it entirely to the fear of those ice-bergs, though by the employment of M. Clement's Submarine Thermometer, they might at all times be very easily avoided. The following is the passage we allude to:—

"DEPARTURE OF THE GREAT WESTERN.—This favourite steamer sailed yesterday afternoon (28th April, 1842) at two o'clock for Liverpool, with seventy-two passengers, about one half the number she can accommodate.

"We stated yesterday that the Siddons and Ville de Lyon carried nearly seventy passengers. We now state that the owner of the Siddons had to turn off several applications, and that the owners of the Ville de Lyon were constrained to put up extra state-rooms.

"The above two paragraphs present two curious facts. Here we see a favourite and very successful steam-ship leave our shores with only half her complement of passengers, and two sailing-ships depart with every berth filled.

"What is the cause of this? Is it because confidence in steam-ships is shaken? Or is it because this is the season for ice-bergs to cover the Atlantic? We believe it is in consequence of the ice. Travellers to Europe having the fate of the President before them, act with more caution, and consequently take passage in one of our fine fast-sailing packets, thinking it best to keep clear of ice-islands two hundred feet high, when they can, and not to run into them at the rate of twelve miles per hour."

4. The fourth invention of M. Clement consists of an instrument which indicates constantly the elasticity of the steam both in high and low-pressure engines, and the level also of the water in the boilers. The instrument may also be applied to the piston of an engine, so as to show the loss of power sustained by the steam in its way to it. A tube, similar to the Manometer, is affixed to the instrument through which the steam ascends, and is introduced into a copper or brass box placed on the deck of the vessel, and upon which a graduated dial indicates, by means of a hand, to the officer of the watch, the effects of the engine, without his having to send below to ascertain it.

M. Clement has obtained Patents for these different inventions both in France and this country. The whole of them are well deserving the attention of our Board of Admiralty, and of the East India and other public Companies connected with shipping—the Submarine Thermometer more especially, which supplies what is at present an absolute want in our maritime service, and would add a wonderful degree of security to navigation, whether the motive power be wind or steam.

## ON ELECTRICAL CURRENTS—AND MR. SMEE ON ELECTRO-METALLURGY.

Sir,—From the account in your Magazine for last month of the experiments of Messrs. Wright and Bain on the Serpentine River, the supposition might be formed that the experiment of passing the galvanic fluid through a great length of water had never before been performed.

I beg leave to call your attention to a work published in 1803, in which it is said that the same experiment was made, with perfect success, in the very infancy of the science. The experiment is given by Aldini, in his account of some improvements in galvanism, and was performed at Calais, across an arm of the sea, between Fort Rouge and the West Mole, a

distance of about 200 feet. An insulated wire was conducted from a galvanic pile of eighty plates of zink and silver across the water, and the circuit was completed by plunging the extremity of the wire into the sea, so that the only passage for the electric fluid was through the water. By this means Aldini was enabled to give a strong shock to any person whose body formed a part of the circuit; and there can be no doubt that the experiment would have answered through a much greater distance of water. In this case there would be the advantage resulting from salt water being a better conductor of the galvanic fluid than the water of the Serpentine River. Aldini also succeeded in passing the same subtle agent for a great distance along the shore. But whilst these experiments prove how easily the electric fluid can be passed through a great length or bulk of water, yet their tendency is to show the importance of continuing to insulate from one another the wires of the electric telegraph; for if a shorter line of communication for the electric fluid is made by the access of water or any thing else, the strength and intensity of the desired effect will be weakened in the same proportion. Suppose, for instance, it is required to telegraph at a distance of sixty miles, the positive galvanic fluid passing along one wire and returning by another placed alongside of it, or at the distance of a few feet—are we to understand that success would be equally certain if the wires were placed in water throughout the whole length or even separated by a few feet of damp earth which has been proved to be so good a conductor of the galvanic fluid? In the account of the experiment of Messrs. Wright and Bain, in which the two wires were immersed in the river and the electric current passed from bank to bank, it is not said whether the experiment was first tried when the wires were above the water, and then compared with the result when the same wires were immersed in the water, which is the obvious method of trying the experiment. In addition, however, to this, the tubing for the reception of the wires has other purposes besides preventing the access of water; its principal use appears to be to prevent the wires receiving any external injury or derangement, to so many varieties of which it is liable, and especially on a line of railway. Supposing that Messrs. Wright and Bain could dispense with the tubing for purposes of insulation, in what situation and under what protection would they propose to place the said wires?

Whilst on this subject, Mr. Editor, permit me to remark that your strictures on Mr. Smee's Work on Electro-Metallurgy which appeared in your Magazine for last month, appear to be too severe, and, in justice to that gentleman, require, I submit, some modification. Mr. Smee states, that "the idea of Electro-Metallurgy appears to have been first suggested by the use of Daniell's Battery." On this sentence you remark as follows: "Where, Mr. Smee, does this appear? In no other page, we are certain, of the history of Electro-Metallurgy that ever was written." Almost immediately after, you quote from *Mr. Shaw's* Book, what you call the literal truth of the case, "We learn by the above extracts, that Mr. Spencer was experimenting with a voltaic arrangement similar to that of Professor Daniell." So that here is recorded a fact which perfectly agrees with the statement of Mr. Smee, which you designate as "falsehood" and resulting from "the wish to extinguish another's well-earned fame."*

But there is yet a rival inventor, who states that his first idea of Electro-Metallurgy was suggested in the use of Professor Daniell's battery. In the pamphlet of Dr. M. H. Jacobi on this subject, translated by Mr. Sturgeon, he says, that his attention was first directed to the subject of Electro-Metallurgy in February 1837, by observing that the copper precipitated in a Daniell's battery had on it the marks and indentations of the copper plate on which it was precipitated, so that here again Mr. Smee's statement is confirmed.

You will observe, Mr. Editor, that I do not seek in the least degree to palliate the neglect and injustice committed by Mr. Smee in omitting to make any allusion to the claims of Mr. Spencer, of which conduct you express deserved reprobation; neither have I any sympathy with those learned Professors or "fellows" of

* "*Literally* speaking, our correspondent is right." The words quoted do not certainly exclude the supposition that it might have been *to Mr. Spencer*, that Daniell's battery suggested the idea; but, as it is obvious from the context that such was not the meaning intended to be conveyed by Mr. Smee to his readers, since he clearly desired to perpetuate an impression that Mr. Spencer had no hand whatever in the discovery, we thought, and still think, him guilty in substance and effect of the offence we imputed to him.—Ed. M. M.

the Royal Society, who choose to take no notice of the merits of Mr. Spencer, simply, as you observe, for no other obvious reason, than because he is not one of their own privileged and prejudiced class. But I think that there is a tendency in you, Mr. Editor, as well as in the minds of Englishmen, generally, to overlook also the claims of Professor Jacobi to at least an original discovery, if not a priority of invention, of the Electrotype.

A similar coincidence appears to have occurred in this as in many other great and useful discoveries, by which two original and ingenious minds arrive independently of each other at the same conclusion. Dr. M. H. Jacobi says that the subject was first suggested to him by some experiments in February 1837, whilst the first experiment of Mr. Spencer, which led the way to his discovery, was not made until September of the same year; and whilst Jacobi produced in public, and before his Majesty the Lord and King of all the Russias, an electrotype as early as October 1838, it was not until about the same time, in the year following, that Mr. Spencer's discovery was announced; from which it appears that Dr. Jacobi was first in the field, though subsequently it seems as if he was almost overcome with difficulties; whilst Mr. Spencer, having once entered on the subject, proceeded from one discovery to another, until he introduced his invention to the public, with scarcely any improvement to be desired; for the separate decomposition cell and the precipitation of the other metals seemed to follow as matters of course.

You observe that Mr. Smee's work is allowed to be defective, remarking on the promise of one-third additional matter in the new edition; I would merely ask, would not the "Manual" of Mr. Shaw, or of any one else, have been equally defective now if published as long ago as Mr. Smee's book? And have not the details of this beautiful and wonder-working art made progress sufficient since that time to require at least one-third additional space?

Requesting you to insert these remarks in your valuable publication—assuring you at the same time that I am perfectly unacquainted with any of the parties concerned, and have written for the sake alone of that "Truth" which should guide us in every inquiry.

I remain, Sir, your obedient servant,

C. W.

## THE MARINE KITE—SIDE SCREW PROPELLERS, ETC.

Sir,—In your Magazine of July 2, there is a very useful suggestion of your correspondent, Mr. J. Jones, for the use of an apparatus which he calls a "*Marine Kite*," intended to anchor, as it were, a ship in such deep water, where no cable or common anchor can reach the bottom. It is a thing that may often be of very saving effect, and *I* can most decidedly vouch for its efficacy, as also point out the most easy and expeditious mode of construction. I have had occasion to try it twice; once in 1822, on the lee shore of the Bay of Biscay; again off the island of Milo, in the Grecian Archipelago, in 1828;—both times in most violent gales of wind and in the night, with water too deep to anchor, and dangerous *lying-to* from lee-way. The way in which I constructed these now so-called "*Sea Kites*" was this. I bound two spars, about twelve feet long, to a studding sail, one at each edge. To the spar intended to be lowermost, I attached several cannon-shot, tied up in pieces of canvass. Six cords were attached to the spars and then joined together. At the junction a hauser was connected, of about 100 or more yards long. The shot caused this screen-like affair to float perpendicularly, and it must be a dreadful gale indeed, and a wonderfully lazy ship to pull it on at an inch in a minute.

In the case of currents, ship and floating anchor might go along in company together, but in ninety-nine cases out of a hundred it may be turned to good account.

I do not know whether this idea and construction of mine were original or not. I should think that it must have struck other people before it did me. But neither of the masters of the ships I used it in had ever seen or heard of it before. It takes but a few minutes to construct. Of course it can be made larger or smaller, according to circumstances—the possession of spars, sails, &c. Only as much shot or ballast iron must be applied as well sink the *lower* spar, and so keep the canvass in a perpendicular position.

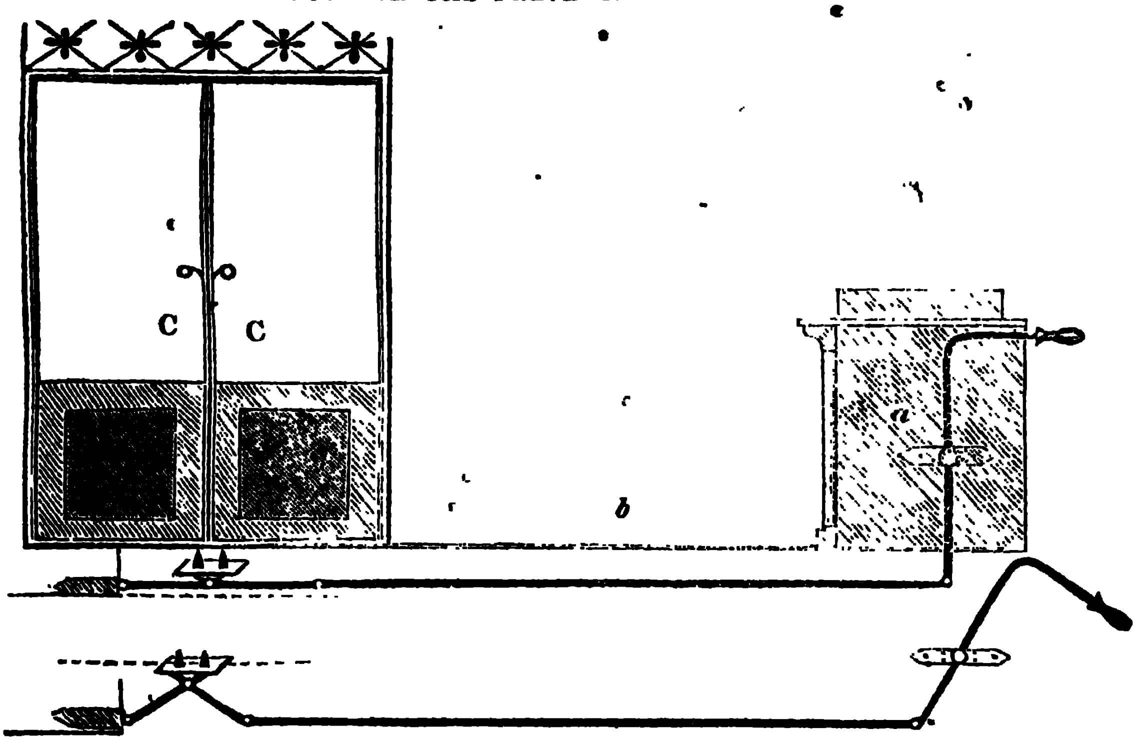
In No. 983, your correspondent, Mr. Frederick Scheer, gives us an idea of screw-propellers to be applied to the sides of a steam-vessel. It happened that when, in March 1828, I presented the Duke of Clarence, Lord High Admiral, my screw-propeller, according to the plan

now called the "Archimedian," I also gave him a model of a screw apparatus to be placed at the *sides* of a ship, if so desired, in the way proposed by your ingenious correspondent Mr. Scheer, in No. 983, p. 473. But the Duke of Clarence rejected both. He also rejected my spiral shot, spiral percussion shells for horizontal projection; my shot-proof iron steam-ships, to be armed with two guns to throw shells horizontally of ten or twelve inches diameter, and only a few carronades at the sides, to protect from boarding; my musket-sail and tilted wagon-burners; my compound naval prehensile rockets, &c. Of the latter he said, that he "would not for the world have such means introduced into the service, because the use of them would place the weak upon a level with the strong, and that as we are the strongest at sea, we do not want them." I replied, that the day might arrive when it would be desirable to have prevented *the weak* from having such means, and that it would be useful to give me some employ at Woolwich, where I could do very good service. But His Royal Highness did not take the hint. I have my correspondence with Admiral Sir Edward Owen, his naval Aid-de-camp, on the subject. All were then neglected—*I* was repulsed. Now, horizontal shells from two large pivot guns, &c. are adopted—after my twenty years preaching!—Something like my wood-paving of 1824!

I am, &c.

F. MACERONE.

## APPARATUS FOR THE PREVENTION OF SHOP ROBBERIES.




Sir,—I beg to submit to your attention a design for the prevention of shop robberies, by the advice of the Editor of the *Sunday Times*, as given in answers to correspondents in that paper of May 29th last. That some remedy of the kind is requisite, it is scarcely necessary to state, and the principle of action of the one now submitted will readily suggest itself to your readers on inspection. Robberies of watches, jewellery, &c., have of late been very frequent, and in many cases the perpetrators have eluded pursuit from having had the advantage in propinquity to the street door.

By my method it will be perceived, that on a person's entrance to a shop, the door may be made noiselessly and carefully fast without exciting suspicion, so that if a pretended purchaser should feel a disposition to bolt out with any article, he would be no less surprised than chagrined to discover that he had been previously bolted in.

The utility of an instrument of the kind is apparent in more than one particular. It would be a good security, and more easily applied than bolts. Or where a female, for instance, is alone in a shop where there are valuable articles,

and which a thief would have a better chance of carrying off with impunity, she would feel perfectly secure, when aware, that the inspector of her stock was already in safe custody. From the very low cost, too, of this contrivance, it may be almost universally adopted; indeed, the bare knowledge that such a means of detection was in existence, would do much to abolish this system of runaway pilfering.

In my drawing, the fastening is shown as effected by the hand, but by a slight difference in arrangement, it might be acted on by the foot—a still better method.

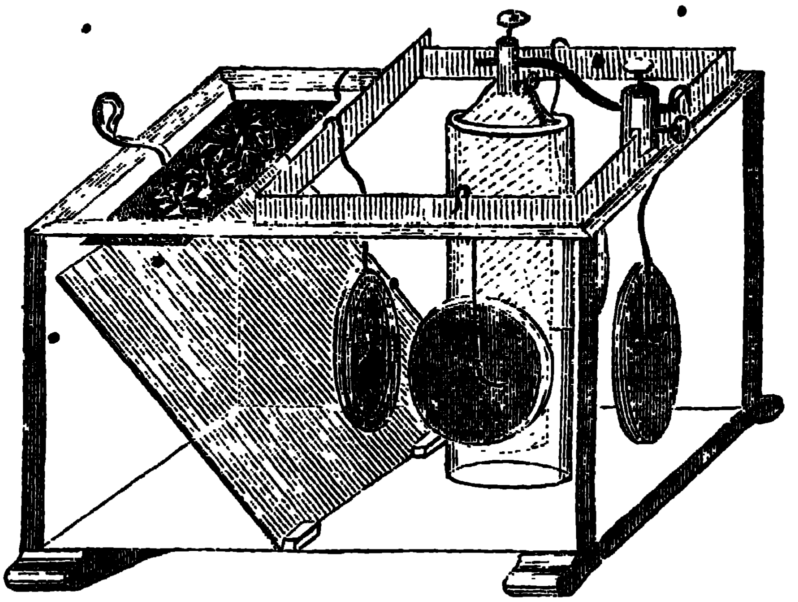
In the prefixed engraving, *a* represents a section of a counter; *b* the shop floor, and C C the street door.

I am, Sir, yours very respectfully,

EDWARD S. BAYSTON.

10, St. Augustin's Parade, Bristol, June 4, 1842.

## IMPROVED ELECTRO-METALLURGIC APPARATUS.



Sir, — Having been engaged for a considerable time with Electro-Metallurgy, and from professing to deal in chemical apparatus having had numerous applications to supply all the requisites for a novice to commence with, the only difficulty I have had to contend with has been the want of a simple, cheap and efficient apparatus. I tried every form hitherto recommended or known, and found something objectionable in all of them; but at length I hit upon the form represented in the prefixed engraving, which, after a fair trial, may be confidently recommended as being the most economical and useful form of single cell yet proposed. It possesses the essential requisites of cheapness, simplicity, and requiring no further attention when set in action, till the acid in the tube becomes saturated.

The crystals of sulphate of copper being placed on the wire frame (which is covered with muslin, and dips just beneath the surface of the solution) are gradually dissolved. The saturated solution being the heaviest, falls down on the glass plate placed obliquely under the frame, and is carried to the part where the medals are suspended, forcing the upper stratum, which is the lightest, from being partly deprived of its copper, to the crystals, which again become saturated; thus keeping up a continued circulation, and maintaining the whole of the solution at its point of saturation, let the decomposition go on ever so fast.

The box is $\frac{3}{8}$ths of an inch thick, and cemented; its inside dimensions are $5\frac{1}{2}$ inches in depth, $4\frac{1}{2}$ inches in width, and 8 inches long; the porous tube is 6 inches high, the copper rim 1 inch wide and $\frac{1}{8}$th thick, bent to a square of $4\frac{3}{4}$ inches, but not soldered. Medals from 4 inches diameter down to seals the size of a sixpence, may be made with equal ease and certainty.

The zink plate may be immersed to any depth, by turning the connecting wire on one side, and placing the binding screw on its edge, instead of the end.

If you think this worth inserting in your valuable periodical, I have no doubt you will receive the thanks of many of your subscribers, as well as of your obliged servant,

W. K. BRIDGMAN.

King's-Lynn, June 30, 1842.

## DESCRIPTION OF A MODE OF CARBONIZING TURF WITHOUT CLOSE VESSELS, THE PEAT FURNISHING ITS OWN CALORIC, WITHOUT PRODUCING ASHES. BY DOMINIQUE ALBERT, LL.D.

[From the Memoirs of the Literary and Philosophical Society of Manchester.*]

When, in 1835, I built my present works at Cadishead, I was chiefly induced to choose the place on account of the proximity of both turbaries, Chat Moss and Barton Moss, having previously ascertained that I could make with turf as good charcoal as with wood.

As the charcoal I wanted was for some chemical purpose other than to be used as fuel, the first condition of the carbonization was, that it should produce a vegetable black, free from the mineral substance mixed with it, as is always the case when turf is carbonized in Ireland, to supply the hearths of some country smithies. I began, then, by submitting the turf to a dry distillation in iron retorts, 5 feet deep to 4 feet diameter, covered with strong sheet iron caps, to which I adapted cast iron pipes. I soon found, however, that the quantity of auxiliary mineral fuel required to burn the turf, owing to the *distance of 7 miles from the nearest* pits, rendered this method too expensive to be continued.

I expected that the acid would compensate for the price of the coal, but I could never get it above two or three degrees; besides, the pyroligneous alcohol diluted in the acid existed in a very small proportion. The tar, which was comparatively abundant, contained the greater part of the spirit, but the low price of tars in general offered me no encouragement to proceed.

I knew, by the discoveries made by my countryman, Mr. Merle, in 1834 and 1835, that certain species of turfs gave a richer and superior gas than either coals or oils, and I convinced myself that the peats in my neighbourhood were of an excellent quality for such a purpose, but I did not feel inclined to set up any apparatus to save that produce, so I turned all my attention to find a cheaper mode of producing pure charcoal.

I had latterly observed the Irish in their process, which consists of setting fire to a few turf cakes placed on the ground, so as to let the air play between. As soon as these cakes are burning, they heap round and above other cakes, which very soon ignite also. They continue to feed thus this heap of fire, till it reaches about 5 feet in height, and 6 or 7 at its base. They let it burn until the whole appears in a complete glow, when they cover it with large wet sods, either of soil and grass or heath sods, from the surface of moss land. This careless, but cheap and easy manner, causes the charcoal to be mixed with a quantity of uncarbonized vegetable, marl, sand, stones, and a notable proportion of ashes, all matters which do not affect the iron jobs with which they come in contact.

The Dutch I saw many years ago, carbonizing peat for domestic purposes, in small conical furnaces, as common with them in the country places as the bread ovens are here. They light the turf from below; and, when the combustion is nearly completed, they close the top and bottom. Their method, though superior to the Irish, and well adapted to their object, is neither as complete, nor does it give so pure an article as I wished; besides, I found its application almost impossible on a large scale.

Amongst the different plans and instructions I consulted to assist my experiments, I gave the preference to a large round perpendicular furnace, in which, according to Dumas, (Chemistry applied to the Arts) M. La Chabeaussiere distils wood.

After having studied what modifications were necessary to render M. La Chabeaussiere's furnace useful for peat's carbonization, without saving either gas or liquids, I constructed the following kiln:—On a solid soil, I made an excavation from 10 to 12 feet wide at the top, 9 feet deep, and 9 in diameter at the bottom, which I covered with a dry brick floor, that had a convexity of 6 inches. I lined this hole round with a dry brick wall, in the way of a common pump pit. At four equal distances at the bottom of the round wall, I opened an air hole of about 4 inches square, and continued it in the form of a narrow chimney outside the wall, to the height of about 6 feet, when I prolonged it about 6 feet more, but in an horizontal direction. For the top of this kiln I had a sheet iron cover made, a few inches wider than the diameter of the brick-work, of a convexity of 2 feet, with a round hole or chimney in the centre, 1 foot high,

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* Vol. VI. Second Series. Just published by Mr. Weale, and, like all the preceding volumes, containing many excellent papers, though certainly on very dissimilar subjects: *ex. gr.* "Blossoms of the Jargonelle Pear," and "Sepulchral Monuments of Sardis," "Rohan Potato," and the "Babylonian Alphabet;"—a diversity which in these days of universal division and subdivision of subjects and societies, may not be very favourable to the sale of the volume. We beg to suggest to the Society, the expediency of publishing their Memoirs in future in two distinct and independent collections; one to include all the Scientific, and the other all the Literary and Miscellaneous Papers. Many would purchase the former, who would not care to burden themselves with the latter, and *vice versa.*—Ed. M. M.

and 9 inches diameter, provided with a cover and handle similar to that of a canister, and at a foot from the extremity of the large cover, are cut out four auxiliary chimneys, at equal distances one from the other, with a 4 inch diameter. Four strong iron rings are fixed to the cover to receive the hooks of a chain, which, by means of a double purchase, raises or lowers the cover.

When this furnace, says Dumas, is filled with wood, the cover is lowered down, and some firebrands are precipitated through the central chimney to the bottom of the kiln; the wood being placed so as to leave a sort of funnel open. By means of the four blowing air-holes the fire is very soon spread in all directions, and its progress is to be regulated by shutting or opening the smoke and air holes, according to the direction of the wind.

These rules, which no doubt did answer when wood was to be distilled, were inefficient when applied to the carbonization of peat; but by dint of trials and patience, I succeeded beyond my utmost expectations, upon the following plan:

I make two tunnels of inch board, 9 feet high and 8 inches square, with some hand-holes from distance to distance. These tunnels I place in the kiln along the side, in order that the bottom end may correspond with one of the four air-holes; one of my workmen descends then to the floor of the furnace, and forms an aerated bed with peat, by setting the cakes upright, with their tops inclined one towards another, so as to create a good draft, which must, as much as possible, run in the direction of both air-holes where the tunnels are standing. It is necessary for this operation that the cakes be entire and dry, as pieces would intercept the air, and a wet cake would paralyze the action of the fire. After the setting of this bed, the peat is thrown down upon it, and left in the natural confusion of its fall, only it is required that a man places round the tunnels the turf cakes in regular order, to build like a chimney round these moveable tubes. When the kiln is filled and heaped up about 3 feet above the level of the hole, the tunnels are drawn out by means of their hand-holes, and leave two square passages from top to bottom. In these temporary chimneys, a few incandescent peat cakes are thrown, and on these some broken pieces of turf, till the passages are filled; but as the air plays more freely through these former chimneys, some barrowfulls of peat crumbs will shut the too wide pores, which places are easily seen by the greater volume of smoke escaping from them. The kiln left open to facilitate a more general conflagration, is not covered before the heap of turf cakes has sunk to the level of the brickwork. In this state, the cover is let down, and some soil is brought round its border to intercept the escape of smoke. In this stage of carbonization, all the air-holes with the large and small chimneys are open.

As soon as the fire is perceived through either of the small chimneys corresponding with the passages where the fire has been lighted, the horizontal mouth of the same air-hole is to be shut with a piece of brick and some marl, and the others are to be successively stopped in the same way, the moment the redness of the fire can be distinguished. If there remains any doubt of the perfection of the operation, a pole about 14 feet long should be thrust through the hole where the carbonization appears incomplete, and by thus gauging to the bottom of the furnace, you will immediately be aware of the state of the charcoal, which you can remedy instantly, by opening the air-hole opposite the place examined.

When the smoke begins to abate, you place the cover on the central chimney, but so as to shut only the half of the aperture, taking care at the same time to direct the open part of the cover towards that part of the kiln, which you might consider not so perfect as the remainder. At last, when the eruption of smoke has ceased, you shut all chimneys immediately, and the operation is at an end. It requires generally twenty-four hours to complete the carbonization of one furnace, and sixty hours for carbonization and cooling of the charcoal. A kiln of these dimensions can receive between three and four one-horse-loads of peat, of about fourteen hundred weight.

There are three kinds of peat. The white, or top of the moss land, is the lightest, and consequently the worst; it is sold from four to five shillings the load. The brown, which comes from the second stratum, is much better, being more compact, and sells at five shillings and sixpence per load. The black, or best quality, sometimes called iron turf, is very hard and heavy: it gives an intense and sharp heat; produces a thick black smoke, with strong and unpleasant smell; it burns slowly, and is bought at six shillings. The incineration of the black turf leaves heavy reddish ashes, whilst those of white turf are of a sulphur yellow, and those of the brown have often a sort of orange tinge.

The peat ashes which owe their alkaline quality chiefly to the presence of lime, are considered a good manure for grass and clover, and used as such in the north of France and in Belgium. March and April are the best months to use them. They are generally sown during damp weather, and will have a good effect used with any plant,

at its first appearance above ground. I tried them last year with pease and other vegetables, and perceived in one instance, that the use of them cleared the cabbage plants of the insects that were devouring them.

In order to get the kiln to act more regularly, it is well to carbonize each sort of peat separately. I have at present four furnaces or kilns at work; they are constructed between two rails, on which I have built a moveable frame, with a roof covered with a tarpauling. This skeleton of a house answers two purposes, namely, it enables the men to fill and empty the kilns in all kinds of weather, and affords to the whole line the use of the double purchase to wind up the heavy iron covers.

The white turf gives a fourth of its weight of charcoal, the brown a third, and the black one-half.

The nature of charcoal from peat is a great deal less pyrophoric than that of wood charcoal; and during the four years that I have had always large quantities in the interior of my works, I have not had a single instance of a spontaneous ignition, whilst I had two accidents of this nature, with wood charcoal, in the short space of six weeks.

## RECENT AMERICAN PATENTS.

[Selected and abridged from the *Franklin Journal.*]

IMPROVEMENT IN THE JACQUARD MACHINERY FOR WEAVING ALL KINDS OF FIGURED GOODS. *Alexander Calderhead.*—The patentee says—"The nature of my improvement consists, first, in lifting and lowering the threads of the warp with what I call independent metallic heddles, or heylds, instead of the weights, males and twines composing the lower mountings, or harness, of the draw loom. Second, in constructing the cylinder, or pattern, so as to directly lift and receive the said heddles, to form the sheed, or shive; or in constructing a trunk and pattern web, both to direct what shall be the sheed as it does in the Jacquard and other drawing machines by trapping or untrapping the hooks, or knot cords, to be drawn up."

A MACHINE FOR MANUFACTURING CANNON BALLS, BULLETS, AND OTHER KINDS OF SHOT FROM MALLEABLE IRON. *Lewis Grandy and Thomas Osgood.*—The metal from which the ball, or bullet, is to be made by means of our machine, is first to be formed into round bars of a size adapted to the kind of shot to be formed. When these are to made of malleable iron, the metal must, preparatory to its being passed into the machine, be brought to a degree of heat nearly equal to that requisite for welding, in a suitable forge or furnace prepared for that purpose. When the balls, or bullets, are to be made from lead, or other soft metal, the heating process is omitted. The machine consists of suitable cutters for cutting off the proper quantity of metal from the bar to form a single ball, or shot, and of an apparatus for receiving the piece so cut off, and rolling it into the spherical form. The rolling is effected by means of channelled pieces of cast iron, or steel, which we will denominate swages. The channels in these, when the swages are made straight, are semi-cylindrical, and by placing swages in pairs, one over the other, with their channels coinciding, a cylindrical cavity is thereby formed. These swages may be either straight or circular; and to one, or to both, of each pair, a longitudinal, reciprocating, or a revolving, motion, as the case may be, must be communicated by suitable machinery.

A MACHINE FOR SPLITTING LEATHER, OR GREEN HIDES. *Alpha Richardson.*—This patent is for improvements in the machines that split the leather by means of a vibrating knife. The gauge-roller, which is placed above the knife to gauge the thickness of the grain side of the leather, works on pivot-screws at each end, that pass through two arms projecting from a tubular shaft, within which a shaft revolves to communicate motion to the gauge-roller by means of two chain bands, one at each end, that pass through openings in the tubular shaft. The table, or bed, against which the cutting is effected, rests on springs, and on its upper surface there is a revolving, elastic, steel rod, against which the flesh side of the leather is borne, and which yields to the inequalities in the surface of the leather. The split leather, or skin, is drawn through, to feed the machine, by means of three rollers geared together.

IMPROVEMENTS IN CLOCKS. *Aaron D. Crane.*—This clock, instead of being regulated by the vibrations of a pendulum, is regulated by the twisting and untwisting of a narrow strip of steel, to the lower end of which a spherical weight is suspended. The twisting and untwisting of the strip of steel, which constitutes the pendulum-rod, is effected by an arrangement of levers connected with the escapement-wheel, but in a manner not easily explained in words without drawings. A rotary hammer, also, is employed in the striking part, instead of the ordinary reciprocating hammer; this hammer is hung by a joint pin to the upper end of a vertical spindle, and is provided with a counter weight to balance it—both the hammer and counter weight, when lying horizontally, may rotate under the bell without striking it, but immediately in front of the

bell there is a short inclined plane, which elevates the hammer sufficiently to cause it to strike as it approaches the bell, and then permits it to fall. The time, or watch part, is driven by a spring, which is wound up by the striking of the clock, and the striking part is driven by a large spring, which is to be wound up in the usual way. On the arbor of one of the wheels in the train of the striking part, there is a barrel containing the spring of the time part, which barrel is connected with the train of the time part; this spring is attached to the arbor of the wheel in the striking train, and its other end forms the connexion with the time part by friction against the inner periphery of the barrel; when the clock strikes, this spring will consequently be wound up, and any excess of winding will be counteracted by the slipping of the spring on the inner periphery of the barrel. In the construction of this time-piece there is considerable ingenuity displayed, but we apprehend that the skill of the inventor would have been more profitably directed in the improving and manufacturing of clocks operated by the ordinary pendulum, which his tortion pendulum is hardly destined to supersede.

DOOR AND OTHER LOCKS. *Solomon Andrews.*—The patentee says—" I denominate this lock 'the combined snail-wheel lock,' which name is given to it on account of its principal characteristics being the causing of the key to carry around with it any desired number of wheels formed of flat plates of metal, which wheels revolve upon a centre pin, and are each of them perforated with a snail-like, or other suitably-formed opening, within and upon which the bit of the key is to act."—The snail-like openings in all the wheels are alike, and the key is formed with projections on the bit of different lengths, one for each wheel, and as the key is turned, the projections being of different lengths, they will act upon the snail-like openings at different parts, and then carry the wheels around. Each of these wheels is provided with a recess so situated, as that when the projections on the bit of the key are all in contact with the wheels upon which they act, the recesses will all correspond, and receive the end of a pendulous lever, which is set in motion by the continued turning of the wheels, by which means the bolt of the lock is shot forward.

IMPROVEMENT IN FIRE ENGINES; *Asa Barrett*, city of Baltimore. The patentee observes that " the usual manner of ejecting water from the engine, is by means of the goose-neck pipe, which is from five to eleven feet long; the bore having a uniform taper through its whole length. Whereas, I contract the length of the joints and the eject-pipe to the short length of from fourteen to seventeen inches: the eject-pipe itself being from three to six inches long." To a pipe, connected with the engine by the usual lower joint of the branch pipe, (which the patentee calls the eject-pipe,) a short cylinder is attached at right angles to the length of the pipe. The branch pipe, which is very short, is attached to a cylinder which turns within that first named, the branch pipe passing through a slot in it, of sufficient length to allow the pipe to play through a range of a quarter of a circle: the inner cylinder has a long opening in it to admit the water from the main pipe. The inner cylinder is provided with gudgeons at each end, that pass through the heads of the first-mentioned cylinder, and these have a lever attached to them for the purpose of governing the elevation of the branch pipe.

IMPROVEMENT IN MAKING BRUSHES; *Robert B. Lewis.*—This patent is for a mode of attaching the bristles, &c., to the handles of brushes for whitewashing and for such other purposes as require brushes to be wide and thin. The bristles are placed on each side of a double champfered bar, and are then confined by a metallic band, made in two parts, and jointed at each end. In this manner the bristles are confined by being pinched between the side plates, or band, and the champfered bar.

IMPROVEMENT IN THE MANNER OF FASTENING AND COMBINING THE TRUSS FRAMES OF BRIDGES; *Jehu Price and James T. Phillips.*—We make the following extract from the specification, viz:—" The peculiarity in the manner of fastening our truss frames and combining them with each other, consists in the employing of the pieces of timber last inserted in putting together the truss frame, in such a way as to cause them to operate as keys, and to bind the whole frame together without its being necessary to use pins, tree-nails, bolts, wedges, or other devices analogous thereto, excepting for fastening down the floor timbers, or such as may be employed in covering in. From the circumstance of these last inserted timbers keying the whole together in a manner similar to the binding together of the toy sometimes called a 'puzzle knot,' we have denominated our bridge the 'Puzzle Keyed Bridge.'"

IMPROVEMENT IN MANUFACTURING BUTT HINGES, BY CASTING THEM IN COMBINED METALLIC MOULDS; *Thomas Shepherd and Thomas Loring.* The patentees say—" We construct our moulds of iron, placing one mould upon another, so as to form tiers, one above the other; and in each mould, at each pouring, we cast a half hinge, the moulds containing, in the first

pouring, a pattern which occupies one half thereof, and which is so constructed that it can readily be removed, leaving the half hinge first cast in the mould; and we then, by a second pouring, cast the second half of the hinges. Instead of a joint pin we usually cast the knuckles of one half the hinge with conical depressions, or countersinks, which are to receive conical projections on the knuckles of the other half; but, if preferred, joint wires may be inserted in the ordinary way, the respective halves being cast without conical projections."

ROTARY STEAM ENGINE; *Jesse Tuttle.* In this engine, as in many of the old rotary engines, the chamber in which the piston works is formed by two plates, each having a semi-circular annular groove, which when put together form the chamber for the rotary piston to work in. The piston is attached to the outer edge of a plate which rotates on its axis between the two heads that form the piston chambers, commonly called the cylinder. On each side of this rotating plate is formed a cam groove, which receives a pin projecting from each side of a forked connecting rod, for the purpose of working the abutment valves. There are two of these abutment valves, placed on opposite sides of the piston chamber, with their forked connecting rods, the pins of which slide in slots made in the outer case of the engine. The steam chambers are situated on each side of the rotating plate, in which suitable appertures are made, as well as in the shaft, to conduct the steam from the side pipes to the piston. There is a sliding valve, with a handle, for changing the direction of the motion of the piston.

IMPROVEMENT IN THE CONSTRUCTION OF WHEELS FOR PROPELLING BOATS, STEAM SHIPS, AND WATER AND WIND MILLS; *John Hobday and William J. Cooke.* In this operation the paddle boards are to pass through openings in the periphery of a hollow drum, and are jointed to a crank within it. The crank remains stationary, but the drum is made to revolve on its axis, and in consequence of this the paddles will be projected beyond the periphery of the drum during one part of their circuit, and will be drawn in during the remainder.

MACHINE FOR HULLING CLOVER SEED; *William C. Grimes.*—The patentee says,—"In the construction of machines for hulling clover seed, it has been a common practice to depend rather upon acute asperities to break the hull, than upon a more permanent principle, or structure, less affected by use; hence such machines have become speedily defective as they became worn; the seed passing through the machine in a current too thin or diffuse for the round teeth or asperities to act with sufficient force upon the light and scattered pods or hulls to break them.

"In my machine the hulling is effected while the chaff and seed (in a mass) is under a pressure produced by centrifugal force; thus the effective power of the machine is rapidly increased with its activity."

A runner is attached to the lower end of a vertical shaft, and is provided with teeth above and below, and on its outer periphery, which is rounded. The teeth on the upper surface extend much nearer to the shaft than on the under surface—the space between the inner ranges of teeth and the shaft being occupied by arms which admit of a current of air to pass upwards. The upper end of the shaft is provided with a fan consisting of arms or vanes—and the whole is surrounded by a case, that part which surrounds the fan being provided with a valve or damper to regulate the current of air, and the part which surrounds the runner with teeth on the inside, to correspond with and pass between those on the runner.

The grain is fed in through a hopper, that opens into the case near the inner circle of teeth on the upper surface of the runner, and by the action of the centrifugal force it is forced outwards, towards, and around, the periphery, and then along the bottom towards the centre, where it meets with a strong current of air, produced by the fan at the top, which carries up the chaff and permits the grain to fall down. The centrifugal force resists the escape of the grain at the bottom, but as the body of grain is greater at the top than at the bottom it is forced out.

Claim.—"What I claim as new, and as my invention, and desire to secure by letters patent, is the manner of hulling clover or other seed, under a pressure produced by centrifugal force after the manner and upon the principle herein before set forth; that is to say, the seed in the hull is passed through a hulling chamber, in which it first diverges from, and is then conveyed towards the centre; centrifugal force subjecting the seed and hull to a pressure, less or greater, according to the velocity of the wheel, spheroid or runner, as it passes over or around the bilge or periphery of the same."

Secondly.—"I claim the combination of the fan with the hulling wheel or ring, and operating after the manner, or upon the principle above described."

Thirdly.—"I claim the mode of regulating or maintaining a nearly uniform current

of air through the machine, by means of a valve or door, operating after the manner or upon the principle herein before set forth."

A REFRIGERATOR; *Job S. Gold.*—This refrigerator consists of a square, or other formed, double box, with a space between the two, filled in with any bad conductor of heat. The inside is provided with shelves, open at the ends to allow of a free circulation of the air from one compartment to the other. At the top, or upper part, there is an apartment, or reservoir, for ice, and at the side there is another reservoir for ice water, the upper part thereof communicating with the bottom of the ice chamber, and the lower end being provided with a cock for drawing off the water.

The claim is, first, to the separate apartment for the ice at the top or in the upper part of the refrigerator, substantially as described. Second, to the combination of the ice water reservoir and the arrangement of the shelves with the apartment for ice as specified, for the purpose of producing the circulation of air to equalize the temperature, substantially as described. And third, to the ice water reservoir in combination with the apartment for ice, as described.

IMPROVEMENT IN THE HARVESTING MACHINE; *Alfred Churchill.*—This machine is intended for thrashing all kinds of grain when standing in the field, without cutting the straw.

There are two chains, one on each side of the forward part of the machine, which chains pass over rollers, or pulleys, and to which four rods are attached at equal distances apart. Immediately back of these chains and rods is placed the thrashing cylinder and concave, which are of the usual construction; and between the chains and rods, and the thrasher, there is a cap, provided with hooks, which slides up and down. As the machine is pushed forward the rods on the chains catch the heads of grain and push them towards the thrasher, at the same time one of the rods on the chains catches the hooks on the cap, which is thus lifted up, the heads of grain are pushed under, the cap is then relieved, falls on to the grain, and holds it during the operation of thrashing.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the method herein described, of gathering and thrashing grain at the same time by means of the revolving rods, and oscillating or revolving cap, constituting the gatherer, in combination with the thrasher and concave, the whole being constructed and operating substantially in the manner set forth."

APPARATUS FOR REGULATING THE PRESSURE OF STEAM AND OTHER FLUIDS, CONFINED IN PIPES AND OTHER RECEPTACLES; *Francis R. Torbet.*—In the constructing of this apparatus one end of a balance lever is connected, by a joint link, with a sliding valve, which governs the inlet of steam or other fluid, and the other end of said balance is connected with a piston which works in a cylinder opening into the pipe or other receptacle, into which the steam or other fluid has been admitted. A sliding counter weight is attached to one end of the balance lever, so that by moving it farther from or nearer to the fulcrum, the pressure of the steam or other fluid will be regulated. It will be evident that if the pressure within the pipe be too great, the piston will be forced up in its cylinder, which, by means of the connexion with the balance lever, will partially close the sliding valve, and *vice versa.*

Claim.—"I do not claim as my invention any parts of the machine as new in mechanics, nor as involving a new or peculiar motion, but I do claim as my invention, and not previously known or used, the general arrangement of the machine herein described and set forth for the purpose of regulating the pressure of steam and other fluids confined in pipes and other receptacles, by means of a piston, moved by the pressure of the fluid itself, and communicating its motion to a slide valve so as to reduce the aperture through which such fluid, but under greater pressure, is admitted."

## CASE IN LIFE ASSURANCE.

Sir,—I send you the following question on life assurance for insertion (and to let you know that I am still alive) in your useful Journal.

IVER, M'IVER.

*Question.*

One hundred individuals, each of the ages of twenty-three, subscribe annually for ten years a sufficient sum each to enable the survivors to receive each 100*l.* at the end of twenty years. How much per annum will each subscriber have to pay for the ten years to afford each of the survivors the above-mentioned sum? The calculation to be made at 3 or 4 per cent., and the survivorships to be taken from the Northampton or any other tables of probabilities. Also, supposing the proprietary of such a scheme to receive one-third of the profits, what will the annual premium be in that case?

## NOTES AND NOTICES.

*The Fountain in Kensington Gardens.*—The water and scenery in that part of Kensington Gardens where this fountain is placed are in a style of what may be termed commonplace nature; but the fountain, which is placed in the middle of the river, consists of a series of circular cast-iron basins, arranged on a vertical axis one above another, exactly like an old-fashioned dumb-waiter. The cast-iron axis rises abruptly from the water; and the whole, which may be 10 or 12 feet high, is painted white. Any thing less in accordance with the surrounding scenery it is difficult to imagine. We have often, when passing this fountain, asked ourselves whether it be possible that Lord Lincoln, and the other Commissioners of Woods and Forests, can approve of it; and, if they do not approve of it, how it happens that such a hideous object, or indeed any object intended to be ornamental, could be put up without their knowledge and approbation. If this fountain had risen out of a base of rockwork it would have been less hideous, but still liable to the objection of being altogether incongruous to the scene in which it is placed. A single bold jet from a mass of rock in such a scene we hold to be admissible, but by no means either a jet or a drooping fountain from sculpture or regular architecture. The most appropriate fountain which could be introduced in this part of the water in Kensington Gardens, is what we suggested in our Volume for 1841 (p. 331), viz. huge masses of rock in the form of a source, placed where the mock bridge now stands, from which the water might trickle down in streamlets. We say this kind of fountain would have been the most appropriate; because, being at the upper end or commencement of the river, or rather lake, it would have indicated how it was supplied, while no violence would have been done to the character of the scenery. Instead of exhibiting a source of this kind, and disguising the termination of the lake by one or two islands, an attempt is made to keep up the character of a river by building three arches as a termination, the commonplace resource, in cases of this kind, in the infancy of the natural style of laying out grounds, but long since rejected by every modern artist of cultivated taste. Altogether, the termination of this piece of water is so bad in itself, and so ridiculous when contrasted with the real bridge within sight of it, that we think it will be instructive to exhibit its absurdity by sketches, which we intend sooner or later to do. The fountain at present only plays occasionally; but, if a rocky source were substituted, the supply of water might easily be so regulated as to flow throughout the whole of that portion of every day during which the gardens are open to the public.—*Gardener's Magazine for June.*

*The loftiest Chimney in the World.*—A chimney has just been completed at the St. Rollox chemical works, near Glasgow, which is supposed to be the loftiest in the world. It rises 450 feet from the ground, and at least 600 feet above the more densely peopled portions of the city and the bed of the river. In relative height, independent of the elevation of its base, it is little inferior to the loftiest superstructures in the world; in absolute height it towers into the air incomparably higher. The great pyramid of Cheops rises 492 feet, but this includes a base of 150. Strasburg cathedral is 474; St. Peter's in Rome, from ground to pinnacle, 450, being exactly the height of this chimney; St. Paul's, in London, 370. The base of the chimney, underground, is 46 feet in diameter; at the ground, 40; at the top, 13 feet 6 inches.

*A new iron Steam Frigate,* called the Guadaloupe, has been built for the East India Company's navy, and will take her departure in a few days. The Guadaloupe is the largest *iron* steamer yet built. Her length, from the figure-head to the taffrail, is 201 feet, and her breadth of beam 30 feet 1 inch, and her tonnage, per admeasurement, nearly 800 tons. She only draws 9 feet of water, with provisions and water for 120 men, and 10 days' coal on board. She carries two large pivot-guns, one forward and the other aft, 68-pounders, on sliding carriages of oak, the under-frame working on circular rails of brass, secured to the deck. The weight of each gun, including the carriages, is from 5½ to 6 tons. She is brigantine rigged, and is a very handsome vessel. She will prove a very powerful coadjutor to the Nemesis, Queen, Phlegethon, and Sesostris, now engaged in the Chinese warfare at Chusan, Chinhae, and Ningpo. The Guadaloupe is built in compartments, and a proof of the efficacy of this plan has been afforded by the Nemesis, which had a hole knocked in her bottom at the taking of Amoy, yet performed important services for four months subsequently without being laid up for repairs. The accommodations for the crew of the Guadaloupe are exceedingly roomy, and there is space for berthing troops, if necessary.—*Times.*

*Going ahead!* The Admiralty made a great step in advance, when they lately ordered the Penelope to be fitted with engines of 650 horse power; but, as if determined to put all competition utterly out of the question, they have since ordered another to be built called the Dragon, which is to have engines of 800 horse power, and will be of double the power of any of our present steam frigates. Not many workshops in Great Britain are capable of producing such enormous engines, and in all France there is not one. Even the Dragon, however, will be inferior by 200 horse power, to the Great Britain (late Mammoth) just on the point of completion, by a private company of adventurers.

*Immense Gun.*—On Wednesday last a barge arrived at the wharf of the Royal Arsenal, Woolwich, having on board the largest gun ever made in this country. A powerful shears was put up expressly for landing this ponderous piece of ordnance, weighing very nearly eighteen tons, none of the cranes on the wharf being equal to the task. The arrangements for landing this great gun were excellently made, and carried into effect without the slightest accident; and the labour of conveying it to the butt, shows great ingenuity, being effected by a coil of strong rope around it, moving the immense mass in a rolling manner along four large logs of wood, changed alternately as the gun progresses. This gun is made on the howitzer principle, and is about 12 feet long, with an immense quantity of metal at the breech. The diameter of the bore is within about one-tenth of 16 inches. The weight of solid shot with which it will be fired is 455lb, and shells of 330lb., and it is expected two solid shot of that weight and four shells in the same proportion will be used when it is proved at the butt. The howitzer was cast and bored by Messrs Walker and Co., for Mehemet Ali, Pasha of Egypt, and two other large guns, 130 pounders, were landed at the same time to be proved for service in Egypt.—*Times.*

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# Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 990.] SATURDAY, JULY 30, 1842. [Price 6*d*.

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## BESSEMER'S PLATE-GLASS MACHINERY.

Fig. 1.

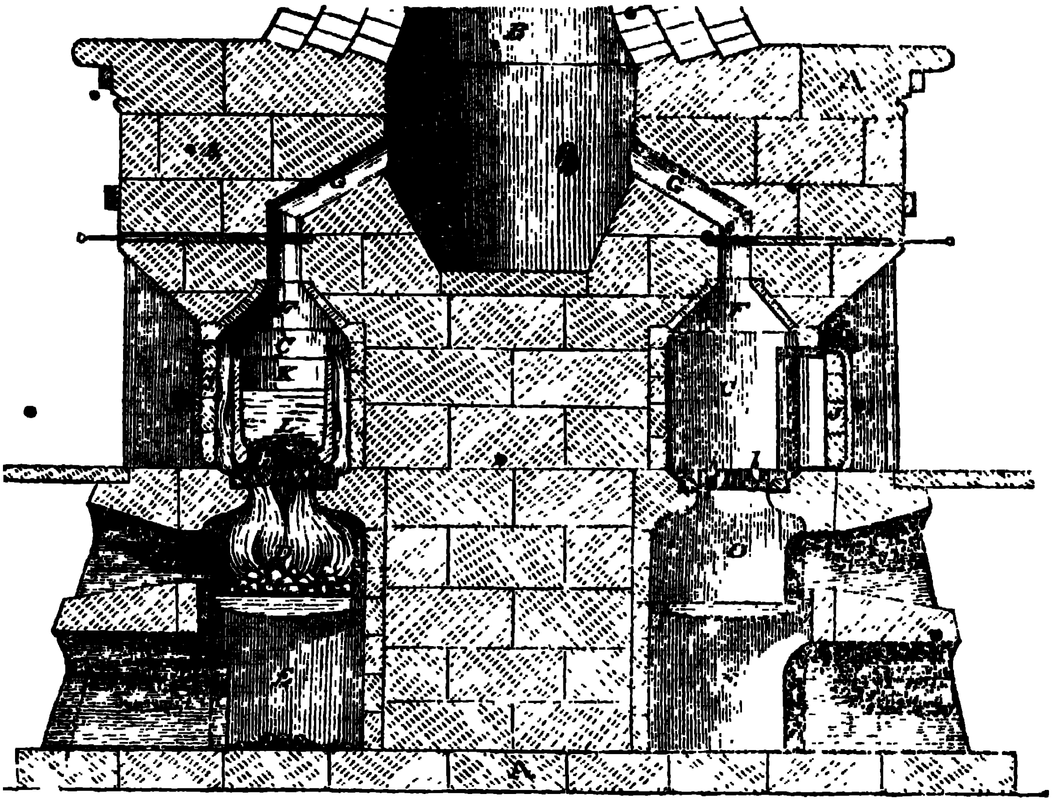
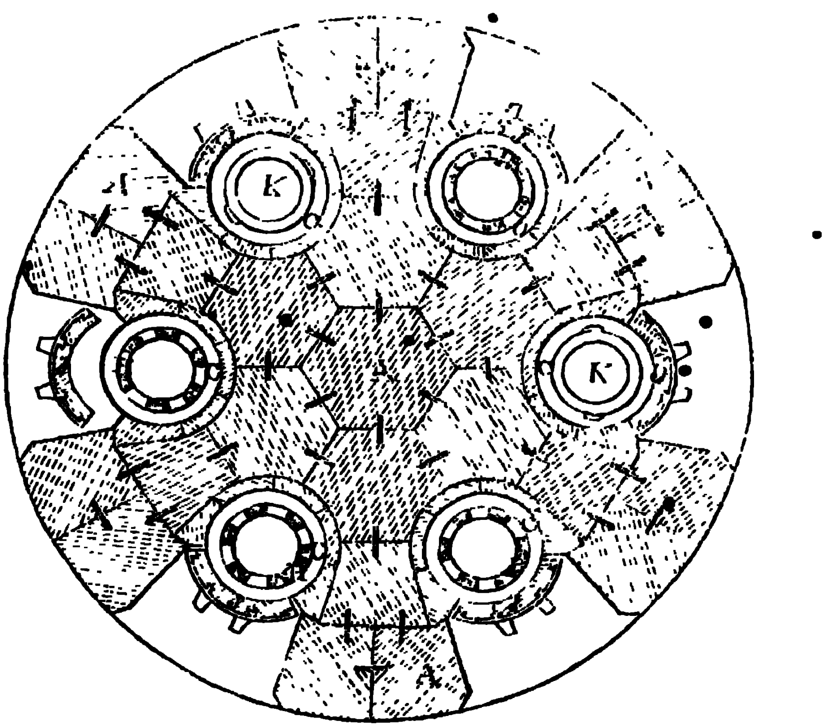


Fig. 2.



## BESSEMER'S PATENT IMPROVEMENTS IN THE MANUFACTURE OF GLASS.

The improvements comprehended under the present patent (dated 23d Sept. 1841) are, if we mistake not, of more importance than any which have been introduced into the glass manufacture for a long series of years. They relate principally to the two descriptions of glass known by the names of plate glass, and optical flint glass. Those which at present concern plate glass we propose to describe very fully; but as the ingenious inventor is now engaged in some experiments which are expected to throw great additional light on the optical flint glass improvements, we shall defer the description of them for a few weeks, in order that we may have the benefit in drawing it up, of the results of these experiments.

The present process of manufacturing plate glass is described by Mr. Bessemer as being defective in the following particulars:—

1st. It has been found that owing to glass being a bad conductor of heat the upper strata in the melting cisterns average 2500 Fahr. of heat more than at the bottom. Now as the salt potass or soda used in the manufacture of glass is evaporable, it is evident that from the increased heat at the surface, the composition of the metal at the top must be very different from that at the bottom of the cistern. Owing to the great loss of salt the refractive property of the glass also undergoes a change, and its rate of expansion and contraction at different temperatures is in like manner liable to be affected, while the increased fluidity of the upper strata adds to the general inequality of the mass. When such a cistern of metal is thrown out on the "casting table," and is rolled into a sheet, the different portions of the metal, with their varied properties, come in contact with each other, and where the more refractive portion joins the less refractive, the defect so commonly occurring (which is called in the trade *wariness*) manifests itself. Its liability to fracture is also much increased, from the different compositions of the various parts in contact, or rather in union, with each other, possessing different rates of expansion and contraction. 2dly. Another defect of the present system arises from the heat being principally applied to the upper surface of the glass in the cistern, whereby the upper stratum of glass becomes hotter and specifically lighter than the under one, which prevents a circulation of the particles forming the mass—the cooler and heavier strata beneath being stationary, by which means the desired equal mixture of the ingredients is greatly obstructed, and the ascent and escape of the thousands of air bubbles or "seeds" (as they are technically called) is prevented, since their floating power is too small to allow of their escape. 3dly. On the old system, in order to apply the reverberatory heat to the best advantage, the mouth of the cistern is left uncovered. This allows dust to fall in,—admits sometimes the smoke, which produces discoloration of the metal wherever it touches it, and sometimes small fragments off the angles of the bricks or stones forming the arch, and what are called "tears," to drop from the arch, these tears being formed by the action of the evaporated salt acting on the fire brick or stone arch, and making a semi-transparent glass, which falling into the cistern produces serious evils. 4thly. The difficulty of removing one cistern in the old furnace without cooling the remainder, thereby creating much hurry and confusion in the casting, from the necessity of taking so little time to empty all the cisterns, while it often occurs that the glass in the cistern last drawn is not in a state to be used, or, at any rate, is much deteriorated in quality. Lastly, The old system of heating is most destructive to furnaces, as their roofs or arches have to receive the heat to be given out to the cisterns, and when these furnaces are once lighted, they cannot be let out again without destroying the arches, and the consequence is, that they only last a short time,—in some cases only about fifteen months.

To remove these defects Mr. Bessemer inserts one or more plates or discs of platinum in the bottom of the melting cistern, as represented in the accompanying engravings, fig. 1 and 2, and places the cistern so as that—

its bottom is exposed to the direct action of the fire. The heated air and flame, after striking the platinum disc, pass through the openings under the cistern into the upper annular space, where they enclose the cistern as it were in a cylinder of flame, meeting over its top in a cone and then escaping into the flue. The object, however, of thus surrounding the cistern with flame is stated to be more for the prevention of radiation from the cistern than for the transmission of heat to the metal. The effect of applying heat through the medium of the thin plate of platinum at the bottom is that those particles of glass which first receive it are expanded, and by their expansion have their

specific gravity lessened, which causes them to ascend while the cooler and heavier particles descend from the surface. The results are a perfect mixture of materials and an almost perfect uniformity of heat, fluidity, and composition of matter. A plate formed of such metal has no false refraction, or wreaths, and is less liable to frac-

Fig. 3.

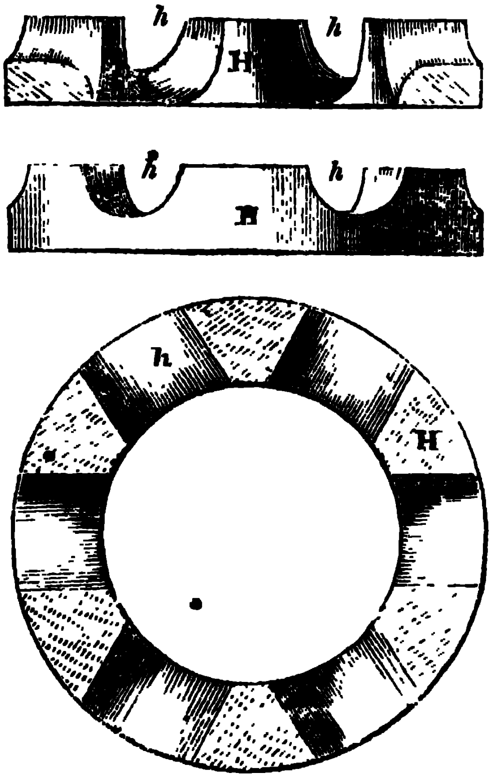



Fig. 4.

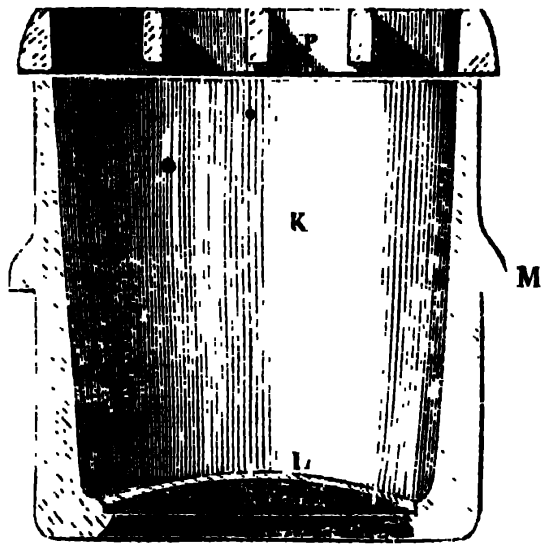



Fig. 5.

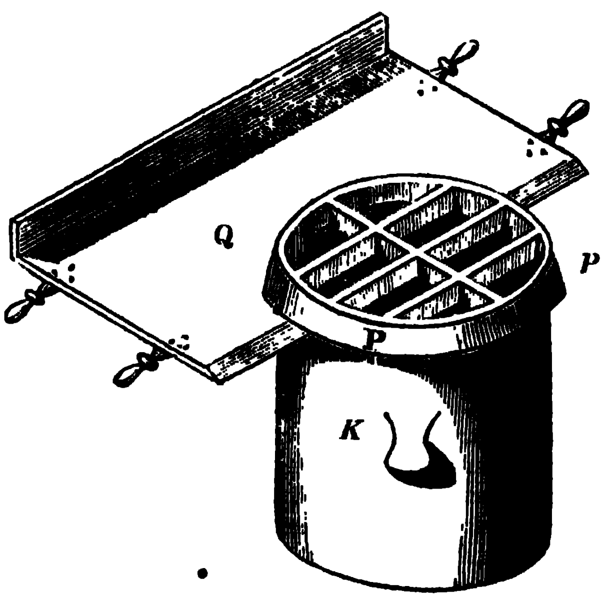
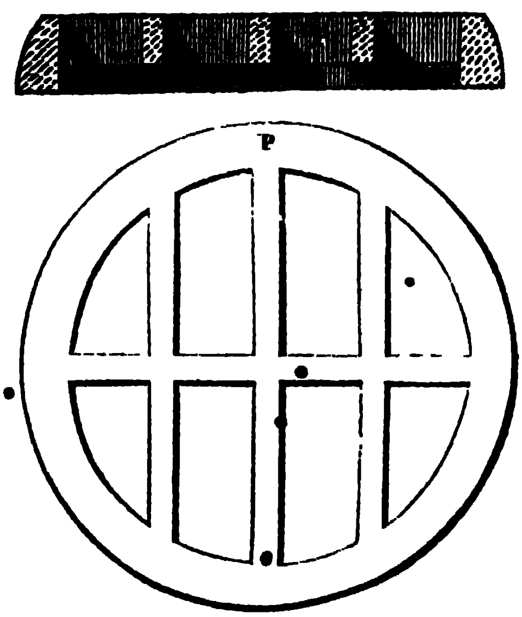



Fig. 6.




ture, owing to the equality of its different parts. A still more important result is obtained by the new arrangement, namely, that thousands of "seeds" or air bubbles, too small to be extricated from a mass of metal in a quiet state, easily ascend to the surface in a fluid, whose particles are in constant motion. Again, by heating from below, the manufacturer is enabled to place a lid on the top of the cistern whereby the dust and

smoke are prevented from falling into it; as also any fragments off the arch and "tears" are effectually excluded. Farther, the destruction of the furnace cannot be so great as on the old principle, where the arch has first to receive the heat. But should it be preferred to leave the cistern uncovered there *is* no possibility of the angles of the bricks falling into it, as the patentee covers the furnace in the manner shown in the engraving, fig. 1, and afterwards more particularly described, with a cone of fire clay in one piece larger in diameter than the cistern. The system of heating from below has also the advantage of considerable saving of fuel and time, as heat is much more easily transmitted through platinum than through fire clay.

Another valuable improvement of Mr. Bessemer's consists in placing each cistern—

in a separate chamber, whereby each cistern may be removed for casting when ready, without lowering the temperature of the rest. In the present furnaces five minutes are allowed for each of the six cisterns (that being the usual number employed) being cast, and if longer time were taken the last would get cold, and if it were left till the heat was got up again, the glass would be spoiled by the undue evaporation of the salt.

The next improvement we have to notice relates to the annealing oven, and consists in—

forming at the bottom of the oven a flat surface sufficiently large for annealing one plate. The oven may contain many such surfaces. Each surface is composed of a number of blocks or hollow tubes, of fire brick or other suitable material, first subjected to a heat at least four times greater than they will afterwards have to undergo. When cold they are fastened or connected together by bolts and nuts, or other means (their sides being ground to fit close,) hollow cubes being preferred for this purpose, as affording facilities for meeting together and giving the required strength with a small weight of materials. These annealing tables or surfaces are ground to a perfect level by the grinding apparatus now used for grinding plate glass. Upon these tables or surfaces the plates of plastic glass undergo the annealing process and are allowed to cool, solidifying in contact with the level surface and thereby becoming equally level. By this means a great saving is effected, as owing to the very uneven surface of the present oven the plate of glass is often so very much out of the level, and the surface so indented, that more than half of the glass is ground away before it is in a fit state for sale; and as the duty is paid upon it in the state in which it is brought out of the annealing oven the loss is very great.

We shall proceed now to describe the accompanying engravings, and in the course of doing so shall have occasion to point out several subordinate improvements of a very useful character.

Fig. 1 is a vertical section of a plate-glass furnace constructed according to Mr. Bessemer's plan; and fig. 2 a horizontal section or plan taken on the line A B, through the upper openings where the melting cisterns are introduced.

A A is the masonry of which the furnace is composed, being built of fire-stone of the usual description. B is the main flue or chimney, C C C C C C six openings or compartments, each forming distinct furnaces with fire-places, D, to each, and ash-pits, E, under the same. The interior of the furnaces C are lined with fire-brick, and at top of each is a conical cover F, composed of the same materials. These coverings have holes at top communicating with the small flues G, which lead to the main chimney B. The flues G are each provided with dampers. The peculiar form of the top F, of the furnaces C, is of more importance than may at first sight appear. In the process of manufacturing plate glass, as at present practised, a considerable evaporation, as before noticed, takes place during the process of melting, and from the usual construction of the furnace and position of the melting pots placed therein, a condensation takes place on the dome of the furnace, which causes what are technically called "tears" to drop into the melted glass, which produce the most injurious effects. It is to obviate this serious defect that Mr. Bessemer gives to the cover F its conical form (glazing it also on the inside) so that any fluid which may form upon it runs down to the base of the cone and drops outside the melting pot. H H is a circular piece of fire-clay, which is moulded to fit the ledge (I) between the furnace C and fire-place D, and upon which it rests, forming a stand upon which the melting pots are placed whilst in the furnace (see figure 3, where these stands are shown on an enlarged scale); there are openings *h* which allow the flame and heat from the fire-place to pass through and circulate round the melting pot. J J are doors composed of fire-brick and strongly clamped together with iron bands which close the furnaces during the process of melting. K is the refining cistern melting-pot, made of the usual material and of the usual form, with

the exception that the bottom L is composed, as before explained, of platinum, and made moveable to allow of its being removed, as occasion may require, to other cisterns. This cistern is shown on an enlarged scale in figure 4.

When the cistern is removed from the furnace, previous to turning out the metal, an operation called "skimming" is usually resorted to as a means of removing the various impurities on the surface of the metal, for which purpose a number of men surround the cistern with a long handled skimmer and take up the glass in small portions and turn it over the edge of the cistern. The evils of this system are, that they cannot see how much or how little they have done from the intense light and heat affecting the eyes, and

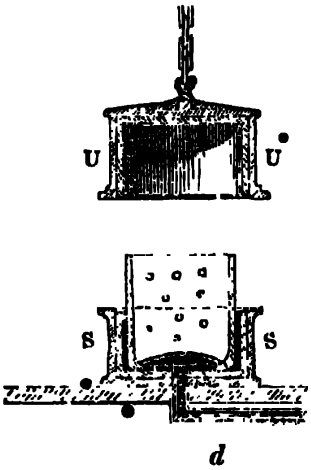



Fig. 7.

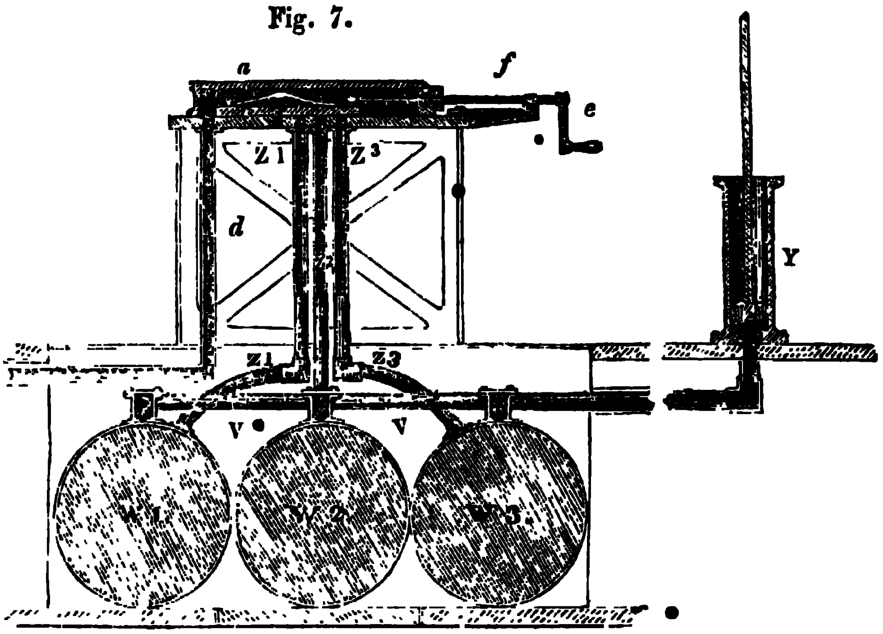
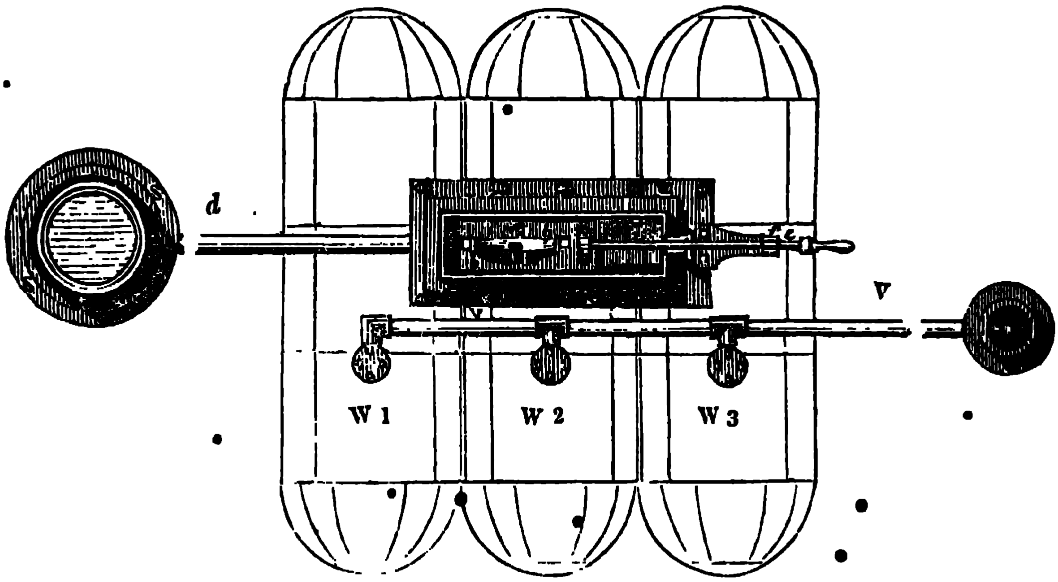



Fig. 8.




that many air bubbles are inevitably introduced into the mass by the falling back of the metal that hangs to the skimmer.

**To effect the skimming without admitting air bubbles into the mass of the melted glass, Mr. Bessemer places—**

barred rings P P on the top of the pots, keeping the level of the glass about the junction of the ring with the pot, and by passing a metal plate Q between the rings and the pot, as shown in figure 5, the ring and the scum within it will remain on the top of the plate, and may be readily removed from the pot. All this is more clearly represented in figure 6, where the ring is shown on an enlarged scale.

**The arrangements for exhausting such air bubbles as may not have escaped**

Fig. 9.

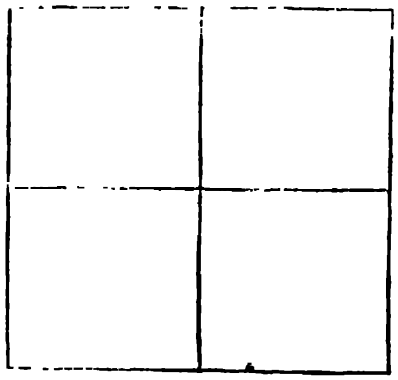


Fig. 11.

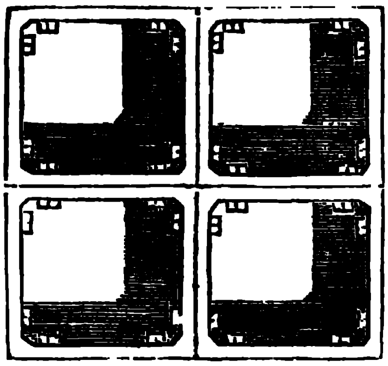


Fig. 10.

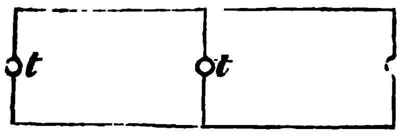



Fig. 12.

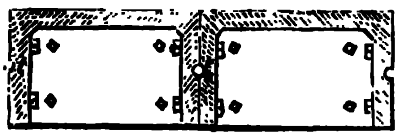


Fig. 13.

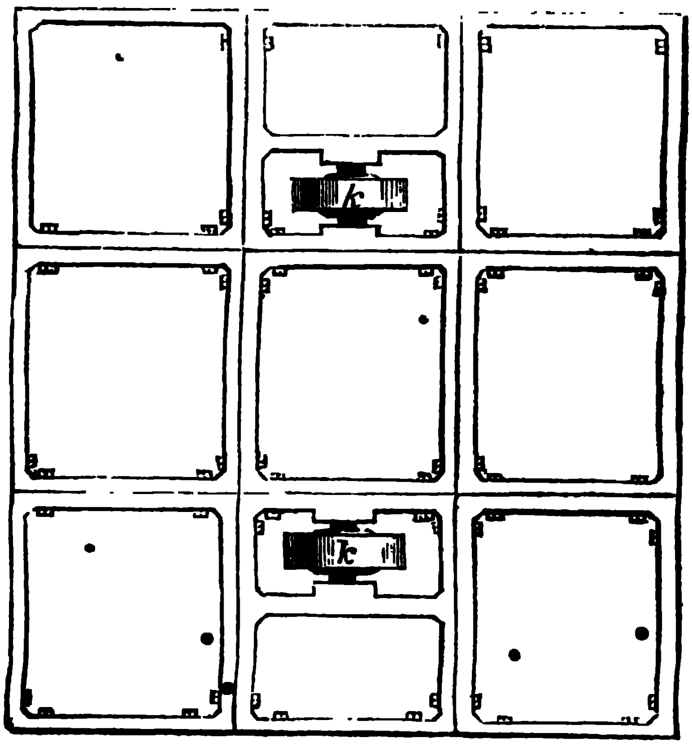



Fig. 15.

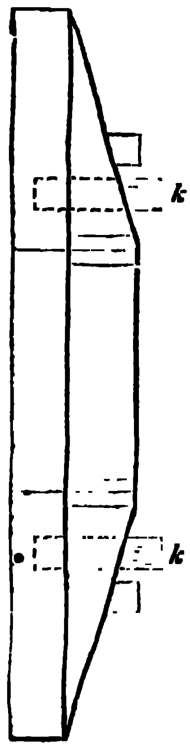
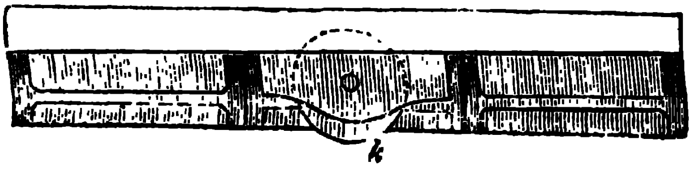



Fig. 14.



during the refining process are shown in the elevation and plan, fig. 7 & 8:—

As soon as the melted glass is removed from one of the furnaces C, the cistern is placed within a metal cylinder S, which is lined with fire-brick to prevent the escape of heat as much as possible, the bottom of the lining being ribbed or grooved so as to form a communication with the opening T in the centre. The top edge of the cylinder S is accurately ground and fitted to the bottom of the cylindrical cover U, which is suspended over it, and as soon as the melting cistern is placed on the cylinder S, the cover U is lowered on to it. Y is an air-pump, which is kept in action by a steam-engine, and communicates with three cylindrical vessels $W^1$ $W^2$ $W^3$ by the pipe V, which form vacuum chambers. To these chambers pipes $Z^1$ $Z^2$ $Z^3$ are attached, which are connected to the valve box *a*, and which in fig. 7 are shown closed by the slide *b*; this slide is provided with a spring and has an opening, C, in the centre to form when moved over the openings of the pipes Z (by turning the handle *e*), a communication between the valve box and the vacuum chambers; but when placed in the position, as shown in fig. 7, a communication is formed between the valve box and the atmosphere, which will allow the air to flow into the cylinder S, by means of the pipe *d*, and the cover U to be lifted up; *e* is a handle, the spindle of which is screwed and works in a box *f*, and by this means the valve is moved backwards and forwards. The object of this apparatus being to extract any air or air bubbles that may be left in the melted glass after it has been removed from the refining furnace, previous to its formation into a plate, it will be evident that if a vacuum is maintained in the chambers or vessels $W^1$ $W^2$ $W^3$, that the air contained in the cylinder S and cover U must rush into the vessel $W^1$ by the pipe $Z^1$, whereby its density will be lessened in proportion as the vessel $W^1$ is larger than the vacant space in the cylinder S and cover U. The further rotation of the handle *e* will bring the slide *b* over the second pipe Z, closing the communication between the cylinder S and vessel $W^1$, and establishing a communication with the vessel $W^2$, and cylinder S, the small remaining portion of air left in the cylinder S again divides itself equally into the increased space thus formed. The still further progress of the handle *e* brings the slide *b* over the opening of the last pipe $Z^3$, and closes the communication with the chamber $W^2$, whereby the minute portion of air left in the cylinder S and cover U again expands itself into the increased space thus formed between it and the chamber $W^3$. By this arrangement of having chambers ready exhausted, an almost perfect vacuum is formed in much less space of time than if the operation had to be performed by the air pump in direct communication with the cylinder, after the cistern had been placed in the cylinder. The atmospheric pressure being thus removed from the surface of the melted glass the globules of air contained therein will become greatly expanded, and thereby acquire sufficient floating power to rise to the surface, and this operation requiring only about two minutes, the glass suffers scarcely any loss of heat, and is now in a perfect state for casting.

The construction of the improved annealing oven is shown separately in figs. 9, 10, 11, and 12, each of which however, represents but one seventh part of the area of the oven. It consists of a number of square blocks,—

which are hollow and open at bottom (as particularly shown in figures 11 and 12.) They may be made of any size to suit the form of the oven, as may be most convenient, but the patentee prefers that they should be about two feet square. The sides are ground and fitted to each other, and they are connected together by screws and nuts, grooves being formed in the sides of each block, into which clay or cement is forced to prevent shifting, as shown at *t* in figs. 10 and 12. As soon as the whole is fitted together it forms a surface on its upper side, as shown in fig. 9; and previous to its being placed in the oven it is subjected to the ordinary grinding machine and made as level as possible, after which it is set in sand in the ordinary way. In some cases it may be desirable to have moveable bottoms to the annealing ovens, and for that purpose the patentee provides rollers *k k*, as shown in figures 13, 14 and 15, upon which it can be moved in or out as occasion may require.

The claim of the patentee as regards the improvements we have described is as follows:—

First, to the forming of furnaces in such manner of solid masonry in the centre and with separate chambers and fire-places arranged round that solid centre, as that each cistern or pot may be heated independently of its neighbouring cistern or pot, and withdrawn from the furnace to be emptied of its contents, when the glass contained therein is in a fit state for being operated upon without affecting the temperature of the other pots or cisterns in the furnace, as shown in figs. 1, 2, 3; as also the conical-shaped covers placed over each separate furnace, and glazed inside to prevent the falling of tears into the

melted glass. Second, the introduction of a platinum bottom to the cistern or pot, and the application of a top ring thereto, as shown in fig. 4; and the perforated ring on which the cistern or pot rests, as shown in fig. 3. Third, the mode of skimming by means of the top ring and handled cutting plate, shown in fig. 6. Fourth, placing the cistern or pot in a vacuum, in order to exhaust the air from the glass contained therein, previous to its being poured upon the table, as shown in figs. 7 and 8. Fifth, the annealing table (the various parts of which the patentee prefers to be of fire-brick, but which may be made of stone of any suitable kind to stand great heat) united together so as to form one solid mass, and ground or otherwise brought to a perfectly level surface, as shown in figures 9, 10, 11 and 12, 13, 14 and 15.

## PROGRESS OF FOREIGN SCIENCE.

### *Belgian Publications on Prevention of Accidents in Mines—Ventilation—The Safety Lamp, &c.*

The Government of Belgium has, within the last few years, set a noble example in endeavouring to elicit all the information that science and experience can produce, with respect to the deeply important questions to that country and to our own, which relate to the best and most effective and practical methods of diminishing the dangers which beset the miner, in coal-pits which are subject to fire-damp. Much as has been effected in our own coal-fields, by the science of such men as Davy, Clanny, and Stephenson, and by the practical skill and judgment of engineers of the class of Buddle, lamentable accidents are even yet of frequent occurrence; but the special conformation of our great coal-fields gives facility for ventilation (the great antidote to fire-damp accidents), which the different structure of the Belgian, and most of the other continental coal measures, does not present.

With a most laudable anxiety to meet these difficulties—to place before the public, for the common benefit of all—whatever had been done in Belgium or other countries, in improving the working of mines troubled with foul air, a Royal ordonnance, of the 22d of June, 1839, founded on a Report of the Minister of Public Works, M. Nothomb, decreed that a sum of two thousand francs should be placed at the disposal of the Royal Academy of Brussels, to found a prize for the best essay on this subject. Government further provided the requisite funds for the publication, in a cheap form, of such of these essays upon the modes of working coal mines subject to foul air, as should be deemed by the commission of the academy worthy of selection for the purpose.

The result was, that fourteen essays were received; some of these were by men whose *ardor scribendi* outran their knowledge of their subjects; but others were considered, and justly, as of great merit. In May, 1840, the Academy heard the report of M. Cauchy, one of the Commission appointed to examine the essays, and determined that in consequence of the publication between the time of the prize being offered and the receipt of the essays, of an elaborate paper, by M. Courbes, in the *Annales des Mines*, on the same subject, the prize of two thousand francs should not be awarded; but that three gold medals, of eight hundred francs value each, should be given to the authors of the three best essays, and two medals in silver to the next in merit, that these five essays should be published at the expense of the state, and fifty copies given to each of the authors, along with the report of the Commission upon safety lamps, instituted at Liege. The essays were all sent in under epigraph signatures—the names of the authors not being known until after the decision. The five memoirs, together with the report upon improved safety lamps, are now published, and constitute a single 8vo. volume, containing a mass of systematized information that, if translated into English, could not fail to be of the highest value to those of our countrymen who are engaged in coal workings, and of whom it must be admitted, that however great and unequalled may be their practical skill, energy, and courage, guided by a judgment the most prescient, still, as a class, the amount of correct and exact scientific knowledge, upon the matters of their own avocations, possessed by them, is comparatively small.

To attempt an analysis of this closely printed volume, so abounding in details, would be impossible; the best idea that we can give of the sort of matter it contains will be by a specimen, and we choose one, *passim*, and will take part of

the second chapter of the second memoir, on the Ventilation of Mines, by M. J. Gonot, engineer in chief of mines at Mons. We take this for a specimen, as placing before the English reader information which we are not aware exists any where within the scope of our own language.

The species of ventilation treated of by the author is that denominated "natural," and is that chiefly in use in England, being the production of a continuous current of fresh air—entering the coal-pit by one vertical shaft, traversing its numerous galleries, and ascending by another, or upcast shaft, and then carrying with it the noxious gases from below—motion being produced and maintained simply by maintaining a difference of temperature between the air in the downcast and upcast shafts.

The upcast shaft, in which the ascending current is maintained, is in England usually heated by a furnace in the bottom of the pit; on the Continent often by high-pressure steam, driven down and discharged from pipes low down in it. By this simple arrangement, coupled with suitable *brattices*, or separations, and air directors below, a continuous current of fresh air, moving at about two feet per second, is maintained, often of many miles in extent, under ground in the coal-mines of Durham and Northumberland.

But to our author:—

"I pass," says he, "at once to the most general case, to that where there exists two apertures, two vertical shafts, for example, of 200 metres in depth, (about the average,) communicating with each other by one or more long and sinuous galleries,—one of these serving for the entrance, and the other for the exit of the air,—having their orifices on the same level, and the ventilation requiring to be artificially maintained. We may compare such a disposition of parts to an immense tube of unequal diameter, having its extremities placed vertically and on the same level. We know, then, that if by any means we disturb the uniform density of the air, filling these tubes—if by any means we diminish the density of that in one of the vertical tubes, or connecting galleries—the equilibrium will be destroyed—the air or other gases in the whole line of tubes will begin to move, passing out by the tube of diminished density, and being replaced in the mine, or galleries below, by fresh air from the outside, which will enter by the other vertical tube or shaft.

If we reduce by calculation the density of the column of air entering to that of the column of air ascending and passing away, (the equilibrium being supposed to be disturbed by difference in temperature,) and and if we call $h$ = the excess of the height of the first column above the second, we know that, friction omitted, the formula which determines the velocity of exit of the air, supposing the tube to be of equal diameter throughout, is

$$V = \sqrt{29h}$$

9 being the velocity impressed by gravity in one second upon a body falling freely in a vacuum, and the value of which is here to be taken at 9·8088 metres, as referred to the latitude and altitude of the observatory of Paris.

"Let, for example, the fluid which fills the tube be throughout the same; let heat be the means of dilating this gas or fluid, and hence diminishing its specific gravity; let the level of both orifices be the same, and their depth = 200 metres; let the heating furnace be placed at the bottom of the upcast shaft, and communicate to the whole issuing column of air a mean temperature of 30° centigrade; let the temperature of the air entering the downcast shaft be 10° centigrade; then, if no velocity be lost by friction against the sides of the shafts and galleries, we have the following calculations as to velocity, &c.:—

"The density of the entering air—that of air at zero, and at 0·76 metres of barometric pressure being = 1 is

$$= \frac{1}{1 + 10^\circ \times 0{\cdot}00375} = \frac{1}{1{\cdot}0375}$$

the density of the issuing air

$$= \frac{1}{1 + 30^\circ \times 0{\cdot}00375} = \frac{1}{1{\cdot}1125}.$$

Dividing the first fraction by the second, to reduce the entering air to the density of that issuing, we have

$$\frac{\frac{1}{1{\cdot}0375}}{\frac{1}{1{\cdot}1125}} = \frac{1}{1{\cdot}0375} \times \frac{1{\cdot}1125}{1} = \frac{1{\cdot}1125}{1{\cdot}0375} = 1{\cdot}0723.$$

Then multiplying this number by 200 = the depth of the shafts, we have 214·46 metres;

from which, deducting the height of the upcast shaft, or issuing column =200, we have remaining

$$h = 14{\cdot}46 \text{ metres.}$$

Substituting this value, and that of $g$ in the formula, we obtain

$$v = \sqrt{2 \times 9{\cdot}8088 \times 14{\cdot}46} = \sqrt{283{\cdot}67} = 16{\cdot}80$$

metres, which is equal the velocity per second of the air issuing from the upcast shaft.

"If we represent by $h$=the height to which the air is rarefied in the upcast shaft, $t$=the temperature of the air entering the mine, and $t'$=the mean temperature of the air issuing from it, and by $a$=the co-efficient of dilatation of gases and vapours, the preceding calculations may be generalized thus:

$$v = \sqrt{2gh\left(\frac{1+t'a}{1+ta} - 1\right)} = \sqrt{2gh\left(\frac{(t'-t)a}{1+ta}\right)}$$

The number, 16·80 metres, thus found, is the theoretic velocity, without deduction for friction, or inequality of area of the tubes; but it is easy to see that in mines the length of the tube is always great in proportion to its section, and that hence we must by no means neglect these causes of retardation. In fact, in a mine of which the workings are as yet by no means large, and with the same data as above, the actual velocity is only 1·15 metres per second, in place of 16·80 metres; that is to say, less than $\frac{1}{14}$th the velocity with which the air would issue from the mine if it encountered no obstacle from the walls and sides of the galleries and shafts."

M. Combes (in the memoir before alluded to) gives a general formula, by means of which he thinks we can calculate the velocity of a current of air in a mine approximatively, and therefore the expense (or volume of air passed through it) in a given time; but this formula is so complex, and requires such delicate and numerous observations, that it seems scarcely capable of being used in practice; and in addition, it has the disadvantage of not involving the principal elements of resistance to motion, in the way in which they are actually combined in the course of working a mine. It may be doubted, also, whether the experiments which have been made on the motion of air in conduit pipes of sheet iron or tin plate, whose sides are smooth or polished, can serve as data whereon to found a theory of the movement of gases in the galleries of a mine or coal-pit, whose form and dimensions are constantly changing, and which are always more or less long, contorted, and rough in their interior walls or sides.

The author, (M. Gonot,) having studied all the formulæ given by M. Peclet in his "Traité de la Chaleur," and deduced from his own experiments on the draught of chimneys, and from those of Daubuisson on the motion of air in conduit pipes, has endeavoured to apply these to the determination of the velocity of air in mine workings; and considers that he has arrived at results which square so well with observed cases, that he does not hesitate to give them place in his memoir:—

"Peclet gives the following formula for determining the velocity of pure air (*i. e.*, atmospheric air) in flues or chimneys of baked clay or pottery:—

$$v = 9{\cdot}12\sqrt{\frac{h\,m\,(t-t')\,D}{L+4\,D}}$$

In which—

- V = the mean velocity of the air in the chimney.
- $h$ = the vertical height of the column of heated air.
- $m$ = the co-efficients of dilatation of gas and vapours = 0·00375 for the degree of the centigrade thermometer.
- $t$ = the interior temperature.
- $t'$ = the exterior temperature.
- D = the diameter.
- L = the total length of the flue or chimney."

The author further remarks, that Peclet has suppressed—erroneously he thinks—the denominator of the fraction which is under the radical, the factor $(1+mt')$ which should be restored; but as the temperature of the air descending into a mine approaches always near to 15° centigrade, we can, by considering this temperature as constant, re-establish the factor in the formula, without destroying its simplicity. For this end it is only requisite to divide the co-efficients 9·12 belonging to the radical, by the square root of the factor—

$$(1+mt') = \sqrt{1+0{\cdot}00375\times 15} = \sqrt{1+0{\cdot}05625} = \sqrt{1{\cdot}05625} = 1{\cdot}0278$$

Let it be, 1·03 it becomes then—

$$\frac{9\cdot12}{1\cdot03}\sqrt{\frac{hm\,(t-t')\,D}{L+4\,D}} = 8\cdot85\sqrt{\frac{hm\,(t-t')\,D}{L+4D}}$$

and we thus fall back upon the formula given by Peclet to express the velocity of burnt air in chimneys; a formula to which we must apply the same correction, in case burnt air may be in action in mines.

The total length of the courses of air in a mine is always very great in proportion to the mean diameter of the galleries and shafts; so that we may neglect the second term (4 D), the denominator of the fraction under the radical. To find the mean diameter D of the shafts, and of the galleries, or drifts, considered as a single canal through which the air is to run, from the mouth of the downcast to that of the upcast shaft, the author multiplies the transverse section of each shaft or gallery by its respective length, adds all the volumes, and divides the sum by the total length of the course = L. (taking care only to reckon as one such portions of the course as are divided into two or more partial or subordinate currents,) as far as the foot of the upcast shaft, or to a cross course, as such are found in well-conducted coal works. He obtains thus a mean section, from which he takes the diameter D, and which, multiplied by the mean velocity V, determined by the formula, gives the volume of warm air due to one second of time at the mouth of the upcast shaft. To render the formula comparable with that already applied, he calls again $t=$ the temperature of the descending current $t'=$ that of the ascending or issuing one, and $a=$ the co-efficient of dilatation; it becomes then finally—

$$v = 8\cdot85\sqrt{\frac{h\,a\,(t'-t)\,D}{L}}$$

This formula is capable of giving results rather too high, so that it becomes unnecessary to take account of elbows or sudden inflections in the galleries, or unusually narrow spots—of the state of the surfaces in contact with the current—or of the volume of carbonic acid mixed with the air, especially in mines ventilated by means of furnaces of dilatation. These, moreover, he presumes, cannot in the present state of science be precisely determined.

Introducing now into his formula the data furnished by M. Combes in the memoir before adverted to, the author proceeds to show how closely his results will square with those determined by actual experiment.

In the Videtta pit, the currents from two downcast shafts pass into a single upcast, and are maintained by a furnace opening laterally into the latter at 120 metres below the surface; the furnace itself being 141 metres below the same. The fire consumes about 500 kilogrammes of coal in 24 hours. The current descends by one shaft, 152 metres vertically, and travels altogether, through winding and irregular channels, about 1,288 metres.

The surface of worked coal is about 33·304 square metres. The volume of air *found* to be received by the downcast shaft is 1·15 cubic metres per second.

The volume of air found to be received by the second shaft per second is 0·96 cubic metres per second; its depth is 135 metres, and the length of the horizontal, or inclined currents, 575 metres.

Finally, the volume of air delivered by the upcast shaft has been found to be 3·81 cubic metres per second—a determination, however, which the author considers too high. The air enters the downcast shafts at a temperature of from 15½° to 16° cent., and the air issuing from the upcast shaft has a temperature of 24° cent., and is observed to vary (with season, &c., it is to be presumed) from 24 to 30 degrees. Admitting that 3·81 cubic metres of air at 24° cent. issues per second, and under the pressure of 0·7547 of mercury = that on the day observed, we find that the weight of air issuing, assumed to be all atmospheric, is 4·44 kilos. per second, or in twenty-four hours 383·616 kilos. The action of the ventilating furnace heats this mass of air from 16° to 24° or to 30° cent. at most, so that the augmentation is about 8° to 14°.

But, admitting the specific heat of air to be 0·26, and that the combustion of each kilogramme of coal furnishes 7,000 units of heat, we find that the 500 kilos. of coal burnt in 24 hours develope a quantity of heat sufficient to elevate the temperature of the whole mass of issuing air 35° cent.; there is hence a considerable loss of heat, which is to be attributed to the damp surfaces of the shafts and galleries.

M. Combes, by whom the above re-

sults have been obtained, does not give the cross section of the shafts; the author, however, from other information, takes them at seven square metres section.

Applying now the dimensions given to the preceding formulæ, he finds in the volume of air in the first case per second, 1·2885386 cubic metres; a result which differs only by 0·14 from that actually obtained by M. Combes experimentally.

So by the second shaft; and summing both he obtains for the volume of issuing air, $1 \cdot 29 + 2 \cdot 22 = 3 \cdot 51$ cubic metres per second, which only differs from actual practice or observation by 0·30, M. Combes' determination being 3·81 cubic metres per second.

Space will not permit us to follow the author through similar and much more detailed and precise comparisons of his theory, with the results of observation in other pits; nor can we transfer the copious and valuable tables by which he has illustrated the variations which take place in the activity of the ventilating current, in relation to variable conditions in the structure of the workings. For these, as well as for the modifications of his formulæ, to be applied in cases of sudden diminution of section (*étranglement*) of the air passages—of changes of forms, bends, &c., we must refer to the original Memoir, which should be in the hands of every coal viewer of sufficient education to comprehend the work in Great Britain; and nothing would be a more acceptable present to British coal owners and coal workers than a good translation of the whole of his report, published in a cheap form, and accompanied with some illustrative notes, comparing our own practices in working coal with those referred to, and showing generally the origin of many of these in the differences of the coal formations themselves.

The author concludes the chapter of his report, of which we have thus given so copious an analysis, by the statement of eight practical maxims or rules to be observed in the ventilation of coal pits by means of rarefaction, and which, in fact, contain, in a condensed form, the whole doctrine; while the next and concluding chapter of his Memoir is devoted to the consideration of its special applications.

Amongst the other Memoirs contained in this report is one by M. Motte, a mechanical engineer of Marchiennes; M. Pont, on the application of the screw as a machine for producing mechanical ventilation of mines, the method being, in fact, an inversion of the screw propeller, now so much talked of, the screw being a fixture in place, and drawing the air through a short tube. Its diameter and velocity are very great, and tables of experiments are given which show its effect in a favourable view.

The volume concludes, as before observed, with a report upon certain improved forms of safety lamps. The presumed improvements consist chiefly in placing strong glass chimneys round the flame, with wire gauze above and below; and in M. Mueseler's lamp, which appears to be the best, accompanied with further precautions against the effects of currents of air, blows, or adhered coal dust, &c. This report contains a useful *résumé* of the important points in the doctrine of safety lamps, but not much that is further important.

R. M.

## NEW FORM OF BATTERY, PARTICULARLY APPLICABLE TO BLASTING ROCKS, &c., BY GALVANISM. BY MARTYN ROBERTS, ESQ., F.R.S.E., M.E.S.

As the process of blasting by voltaic agency has become very general, it may be interesting to our readers to learn the construction of a very simple and effective battery adopted for this purpose by Mr. Roberts, and communicated to the London Electrical Society at their meeting on Tuesday, the 19th inst.

Some four years ago, Mr. Roberts communicated to the Royal Society of Edinburgh, the superior efficacy of combinations of zinc and *iron* over those of zinc and *copper;* twenty-six inch bars of which he finds most efficacious for a blasting battery. As the great value of this arrangement depends upon the peculiar manner of connecting the respective metals, we will do our best so to describe it as to enable our readers to construct for themselves. Twenty plates of iron and a like number of zinc are prepared, and are placed parallel and alternate to each other, as in the ordinary arrangement for the acid battery; and they are thus connected:—let the zinc plates be numbered 1, 2, 3, &c., and the iron *a*, *b*, *c*, &c.; and let *a* be at one *end* of

the series: then first connect $a$ and $b$; and afterwards connect 1 to $c$, 2 to $d$, and 3 to $e$, and so on. A rough sketch of such an arrangement will show that *all of both* sides of *each* plate is brought into active service, and that there are no counter currents. A box 8 inches long, will contain a series of 20, and may be of wood rendered water tight by white lead. To facilitate the removal and immersion of the plates, a frame is made to contain them. The battery is excited with one of sulphuric acid to thirty of water.

A MILITARY MACHINE TO PROPEL BULLETS WITHOUT THE USE OF GUNPOWDER.

Take a circular metal plate, not less than six feet in diameter, upon the upper surface of which trace round the centre a circle of 18 inches in diameter. At equal distances from each other fix four straight bars extending from the perimeter of the lesser circle to that of the plate. Let four other bars, touching those at the exterior of the smaller circle, be placed obliquely upon the plate so as to reach the rim at an inch distant from the others in front of them. If the circular plate be now made to revolve upon a vertical axis, and bullets be thrown upon it near the axis, they will be carried to the outward extremity; and will fly off with a force which may be measured by the velocity with which the plate is made to revolve; and they must fly off from the points at which the conducting bars are nearly in contact at the circumference of the greater circle.

It remains to render these points of escape, fixed and stationary points during all the revolutions of the plate. Let an upper plate cover all the above bars outside the smaller circle, leaving a void round the axis for admission of the bullets. Supposing the machine with its axis to be now firmly fixed upon a proper horse carriage, let an iron hoop surrounding the circular plates be independently fixed upon the same supporting frame, but in such a manner that the plates can revolve freely within the hoop, which shall remain undisturbed. The bullets will have the same tendency to fly off as before from the machine. If a hole is cut in the surrounding hoop, the bullets will all of them fly off at different instants of time from that fixed open point; and if the velocity of the plates is continued uniformly the same, they will continue to fly off with the same force, and in the same direction, which will be nearly in that of a tangent to the circle, and they will all of them strike any prominent object not too distantly stationed in that line. By a few repeated experiments, the course of the bullets could be accurately ascertained in its degree of variation from the real tangent. Allowing for this ascertained variation from the real tangent direction, and using the diameter of the exterior orifice as that line, the bullets may be made to strike any object within reach, although placed considerably on one side or the other of that line. The hoop, being independant of the revolving plates, might by a mechanical expedient be made to turn a little either way in a moment, so as to give the tangent or line of guidance every useful and efficient direction. This machine would throw off more bullets than a thousand muskets; and if properly managed, would destroy any military column advancing to approach it.

The most powerful agent would be steam, acting as immediately as practicable upon the axis. But a substitute much more convenient in practice might be found; springs might be formed to act by their elastic powers upon the axis; and these springs might be compressed from time to time by the action of a portable steam-engine. This engine, being of small dimensions, might be conveyed upon a separate horse carriage; and would serve to compress the springs of many propelling or propulsive machines. The springs could not often be required to act for more than a quarter of an hour, at the same time or in the same situation; and convenient intervals for fresh compression would frequently occur. Mr. Atwood and other celebrated mathematicians have so ably demonstrated the force with which a rapidly revolving cylinder would propel a ball, that it is sufficient to allude simply to the circumstance, without supporting it by any particular illustration. They say that the force would equal that of a full charge of gunpowder.

These suggestions are offered to the consideration of professional gentlemen who combine a perfect knowledge of military and mechanical science.

E.

## ON THE ACTION OF LIGHTNING CONDUCTORS. BY CHAS. WALKER, ESQ.

[Abstract of a paper read before the London Electrical Society, July 19th, 1842.]

The object of an extensive series of experiments related in this communication is to illustrate the following opinions:—

1st.—That the discharge of a Leyden jar does not resemble a flash of lightning; and, therefore, that Leyden jars should not be employed in investigating the action of lightning rods.

2nd.—That the discharge from a prime conductor does, in all essential points, resemble a flash of lightning; and is therefore admissible in such experiments.

3rd.—That a wire, on which sparks are thrown from a prime conductor, represents a lightning-rod.

4th.—That sparks will pass off from such a wire, and, therefore, from a lightning-rod, to vicinal conducting bodies; and,

5th.—That these sparks may be prevented by connecting the vicinal bodies with the rod itself.

The experiments were made by aid of the magnificent machine of the Polytechnic Institution, and are supported by a course of reasoning based upon the dissimilarity between the Leyden light and a lightning flash, and the resemblance between the latter and that from the prime conductor. It was shown that the length of the spark from the conductor is due to the action of *one* force in *one* direction; and that the shortness of the Leyden discharges is due to *two* forces, acting in *opposite* directions. The importance of excluding the Leyden experiments from the field of inquiry is very evident from the fact that on them hinges a large portion of the conflict of opinions. Using the new prime conductor and throwing sparks from it upon wires subjected to every variety of arrangement "lateral sparks" were always obtained, unless vicinal bodies were in close metallic connexion with the wire conveying the charge. This fact was illustrated by a most important modification of the well-known experiment with the metallic discs; and if this modification, which consisted in erecting an elevator rod beneath the great globe, forming the prime conductor, be legitimate, the danger of lateral flashes is evident.

## SUPPLEMENT TO PRACTICAL GLEANINGS, FROM THE TRANSACTIONS OF THE MANCHESTER MEETING OF THE BRITISH ASSOCIATION.

### LOCOMOTIVE AXLES.

*Mr. Nasmyth* brought forward (27th June) several specimens to illustrate some remarks which he intended for further illustration of his previous observations on this subject. (See *Mech. Mag.* No. 987, p. 31.) From late accidents, arising from breaking axles, the public were alive to the subject, and it was desirable that the question should be examined. In locomotive engines the axle was the chief point of danger; and it was therefore important, both as a scientific and practical question, to determine the nature and habitude of iron when placed under the circumstances of a locomotive axle. Experiment was the only way to discover this, and he would have wished to place iron under exactly similar circumstances; but the short time intervening since the previous meeting, had rendered it impossible to do so. One opinion then was that the alternate strains in opposite directions, which the axles were exposed to, rendered the iron brittle, from the sliding of the particles over each other. To illustrate this, Mr. Nasmyth took a piece of iron wire and bent it back and forward, it broke in six bends. He had suggested annealing as a remedy for this defect: in proof whereof, he took a piece of annealed wire, which bore eighteen bends, showing an improvement of three to one in favour of annealing. He should therefore advise railway companies to include in their specification, that axles should be annealed; he did not like the custom of oppressing engineers with useless minutiæ in specifications, but this was so useful and so cheap, that he considered it ought to be insisted on. To exhibit on a larger scale the effect produced on iron in our workshops, he showed a specimen of iron as it came from the merchant: being nicked with a chisel, it broke in four blows with a sledge, at the temperature of 60°, with a crystalline fracture; by raising the temperature 40° higher, it bore twenty blows, and broke with the fibrous or ligneous fracture; so that the quality of iron was not the only circumstance to be considered as influencing the fracture. I noticed also, said Mr. Nasmyth, at the last meeting, the injurious effect of cold swaging, as causing a change in the nature and fracture of the iron; and here let us take the practical workshop view of the case, and not run after the *ignis fatuus* of electricity or galvanism, but consider the practical effects. Swaging was necessary in many cases; for instance, when an axle had collars welded on, these could not be finished

with the hammer, and certain tools called swages were used, from the action of which great condensation of the iron took place, and a beautiful polish was given to the surface, with what injurious effect he would show by the next specimen, which had been heated red hot, and then swaged till cold; it broke at one blow without nicking, and the fracture was very close and beautiful, like steel. This showed the fallacy of considering close fine grain a good test of excellence in wrought iron; but moderate swaging was often necessary, and not injurious, unless where an over regard to finish carried it to excess. To prove that annealing restored the toughness and fibrous texture, a portion of the last bar was heated, and cold-swaged till cold as before, then heated dull red, and left to cool gradually; it bore 105 blows without breaking, and at last was rather torn asunder than broken, as was shown by the specimen; this proved that the fibrous structure was restored by annealing, and he therefore thought it should be insisted on in specifications. The effect of heating to welding-heat was very injurious, unless the iron was subsequently hammered to close the texture; a piece of the same iron heated to welding, and left to cool, broke without nicking, in one blow, showing very large crystals, especially in the centre. The effect of nicking was also very singular. The strength of iron was generally stated to be equal to its sectional area; but a nick not removing $\frac{1}{100}$ of the area took away $\frac{1}{10}$ of the strength. Mr. Nasmyth broke a piece of nicked, or rather scratched wire, to illustrate this point. These, and similar things, did not prove that science and practice were at issue; but, as Halley reached the great accuracy of his prediction of the return of his comet by taking into account the disturbing forces of Jupiter and Saturn, and the other planets amongst which the body had to pass, so scientific men should seek in the workshops correctional formulæ, by learning there the practical occurrences which would elucidate their theories, and he hoped that these specimens might be of some use.

Prof. *Willis* was aware that many subjects of a purely physical nature could only be explained by practical research; and one great advantage of the British Association was, that it brought scientific and practical men together for this purpose.—*Mr. Fairbairn* was of opinion, that the two chief causes of breaking axles seemed to be bending and percussion, changing the fibrous into the crystalline structure; this last was the effect of cold swaging, and he hoped that his friend Mr. Hodgkinson would undertake a series of experiments on this very interesting subject. By nicking a bar the *extended* fibres were cut, which supported more of the weight than the *compressed*.—*Mr. Worthington* thought the additional friction in steps, given by annealing, would counterbalance the advantage gained in strength, as case-hardening (the very opposite operation) was used to diminish friction, by giving a glassy hardness to the surface, the annealed axles would be laid aside after a few trips, from the friction: he would wish, as a security for life, that the springs should be made as long as possible, to diminish the effect of concussion.—A Member showed specimens of pins which had broken in machinery. They appeared very crystalline in fracture; the bar from which they had been made was fibrous and tough: showed also specimens of tender axles broken on the Sheffield and Rotherham railway. Tender axles most frequently broke from the action of the brakes on the wheels; crystals larger in the centre of the axles than at the ends.—*Mr. Mallet* was quite at issue with the French committee on the very uncomfortable Report which they had made so authoritatively; he believed that the alternate strains, as long as they were within the limit of elasticity, did not injure the texture of the iron. Wire might be bent backward and forward to infinity, if we kept within this limit. The effect of nicking depended on a change of crystalline structure; that the effect of the nick in determining fracture, was according to the sharpness of the chisel, and the direction; a nick sloping, according to the natural direction of the fibre, was not so efficacious; a molecular change was effected by this cutting across the fibres: we, in fact, established a plane of cleavage in the iron; this took place in glass, when scratched with a diamond, although glass, from passing through the intermediate viscous state, did not crystallize so definitely as iron, which crystallizes *per saltum*. Iron, polished and placed in such a situation as just not to corrode, if scratched, immediately began to corrode; and iodide of mercury presented a curious example of entire disintegration from a slight scratch. Crystallization takes place in the direction of motion; in rolled iron the motion was in the direction of the length of the bar or plate, and percussion, in a direction perpendicular to that, had the effect of breaking up these laminæ or fibres of crystals, into their original molecular arrangement; and this effect was proportionate to the temperature caused, and extent of motion imparted. But he believed, that to effect this molecular alteration required more violence than was to be expected in any ordinary railway travelling, or, indeed, any circumstance of machinery in perpetual work. The chief danger was to be feared where any cutting perpendicular to

the direction of the fibre took place, as, for instance, shafts, with square collars, would break at these collars, while a little rounding out preserved them. That rotation of iron induced magnetism, he was aware, but he did not believe that either rotation or vibration would affect iron which was sound when first applied. If this theory were correct, the engineer should discard wrought iron entirely; no engine was safe, no suspension bridge should be trusted.—Sir *J. Robison* considered that injuries did arise from vibration and alternate bending; he instanced tongues of musical instruments, and the effects of bending pure tin, which crackled and broke when very slightly bent in opposite directions. Mr. Mallet believed those tongues to be alloyed, and he found that alloys altered their crystalline nature from mere lying by, as tough brass became brittle, &c., which did not happen in simple metals.—Mr. Nasmyth showed that the effect of hammering bars was actually to make them hollow; every stroke had a tendency to make the bar an ellipse, and the intersection of all their axes was apt to be a hole, from the sliding of the laminæ over each other.

### THE HOT AND COLD BLASTS.

*Mr. Fairbairn* read his Report 'On Experiments on the Transverse Strength of hot and cold blast Iron.'—The bars, as described in the former Reports, were supported by standards, 4 feet 6 inches apart, and were loaded with different weights; they were occasionally carefully examined, and showed a very slight progressive deflection. He had no doubt that they would ultimately break, but the progress was very slow. He read a table showing the weights laid on, and the deflections of each bar.

*Mr. Hartopp* said, that Mr. Fairbairn's former experiments on hot and cold blast iron, had created a false impression with regard to the strength of hot blast iron. Mr. Fairbairn had found very little difference between the hot and cold blast; but his experiments, made with great accuracy, and in which the weights were laid on with great care, were of little practical advantage, as these were not the circumstances under which iron was tested in practice: there percussion, violent and sudden impact, should be expected, and here lay the great deficiency of hot blast iron. Even in Mr. Fairbairn's experiments, Oldberry, No. 2, cold blast, bore twice the percussion of Oldberry hot blast; and Milton hot blast was only half the strength of Elsicar cold blast, made of the same ore and smelted with the same coal. Experiments had been made in Yorkshire with great care; the results being, Low Moor cold blast bar iron, 3 inches diameter, broke with 6 blows, ditto Scrap, 3 blows, ditto hot blast, 1 blow; again, Low Moor cold blast 18 blows, Bierly, ditto, 18, hot blast of as good materials, 3 blows; again, Elsicar cold blast 21 blows, Milton hot blast $1\frac{1}{2}$ blow; therefore, in iron for axles this difference of at least $\frac{5}{6}$th of the strength was very important. As to scrap iron it bore too high a character. Scrap, made on the old plan, was all charcoal iron, but the modern scrap iron was very inferior, being 32*s*. 6*d*. per ton cheaper, so that ironmasters put off as much of this cheap material as possible. Hot blast iron was rejected now for water pipes, &c. and even for cannon balls; and, in fine, he had been told by very eminent marine engine makers, that where any percussion took place, hot blast cast iron was only half the strength, and wrought iron only $\frac{1}{8}$th the strength of cold blast.—Mr. Fairbairn explained, that he had found great difficulty in obtaining specimens from the different iron-masters, who would of course send, when possible, the best specimens, but every care had been taken to insure accuracy in the experiments.—*Mr. Hodgkinson* said, that the average strength of hot blast had been $\frac{3}{100}$ weaker than the cold, but the inferiority was chiefly in the softer irons; as the hardness increased the two kinds approached to equality, and in the hardest irons the hot blast was the best. He thought his experiments, made without any interest on either side, and with the greatest care, were more to be depended on than experiments made by those who had an interest in the result.—Prof. *Vignoles* explained, that the question of hot and cold blast had nothing to say to the late contract for cannon balls.

### STRENGTH OF MATERIALS.

Mr. *Hodgkinson* explained his apparatus for trying the strength of materials. He brought his apparatus forward, as he had made many experiments; and he was desirous to render them as trustworthy as possible, by convincing the members that every care had been taken to insure accuracy. Other experiments had been rendered unworthy of reliance, from injudicious methods of affixing the testing apparatus—as those of Rennie and Capt. Brown on iron; Girard's experiments, &c. In crushing specimens, it was necessary that both ends should be well bedded, and the pressure transmitted through the axis. To this, other experimenters had not always attended, and by using the pressure of bores directly on the substance to be crushed, they introduced the different errors arising from the pressure being oblique, transmitted through the side, or being exerted on mere points, instead of equably exerting its force over the entire top surface:

to obviate these objections, he had devised apparatus by which all these errors were avoided. Mr. Hodgkinson explained the crushing apparatus by drawings, &c. In experiments on tearing asunder, he had also taken great care, by means of apparatus, which he exhibited and explained, that the strain should be through the axis, and otherwise free from causes of error. Mr. Hodgkinson explained his experiments on torsion, and illustrated his observations throughout by many models and specimens of the substances on which the experiments had been made.

Professor *Moseley* asked whether, in the experiments on beams, care had been taken to obviate the effects of the friction of the beams on the supports, as this would affect the direction of pressure, altering it from vertical to inclined, and the neutral line only passed through the centre of gravity of the beam when the pressure was vertical: also if care had been taken in laying on the weights, as a weight suddenly laid on produced mathematically twice the effect in deflection. Theoretically, the weight should be increased by small additions, even as grains of sand.—Mr. *Hodgkinson* said he had taken all precautions with regard to the weights; they were added by small portions, and with great care; the beams rested on tolerably smooth cast-iron, on which he believed the friction would be of little importance.

### BROCKEDON'S CAOUTCHOUC STOPPERS FOR BOTTLES.

Mr. *Brockedon* exhibited specimens of his patent India-rubber stoppers for bottles, explaining the late improvements in the construction of the cores on which the India-rubber is spread. The present cores, he said, were made of cotton twisted into strands, &c., by means of a machine which he explained by a diagram. The cylindrical rope now consisted of several strands of tightly twisted cotton, lapped with flax thread, and laid together longitudinally, loose fine cotton rovings being placed between them; the entire was then lapped in a cylindrical form with flax thread, attaining by this method the advantages of perfect roundness and firmness; they also gave sufficient hold to the corkscrew, and bore the heating process well. These stoppers would slide on glass when wet, but not when dry, (although there was no cohesion in this latter state,) so that the bottler, by slightly wetting these stoppers with the liquor which he was bottling, could easily insert them; and when this slight film of moisture was dried up, the stopper required considerable force to withdraw it.

### THE RIVAL RAILWAY SYSTEMS—RAILS WITH CHAIRS AND WITHOUT.

*Professor Vignoles* read a paper "On the best Form of Rails, and the Upper Works of Railways generally."—He wished to compare the two chief systems of laying down rails, with chairs and without, and to do so he referred to two diagrams:—No. 1, exhibiting the heavy rail and heavy chair used on the South-Eastern Railway, the weight of rail being 80 lb. per yard, and the chair 20 lb.: the rail was fastened in the chair, not with iron, but with a longitudinal plug or key of wood; this mode of laying rails was found to answer very well.—No. 2 was invented by Mr. Evans; it was rolled with a slot or groove running along its under side; this slot, after coming from the first rollers, was rendered dovetailed by compressing the bottom edges of the rail towards each other, thereby narrowing the slot at the bottom. These rails required no chairs, having a continuous bearing on longitudinal wooden sleepers, being fastened down by bolts, with dovetailed heads slid into the groove, and which, passing through holes in the timbers, were secured with a nut and washer at the under side. He had suggested this improvement, as they had been previously fastened with a cotter. By this method, all the difficulties attendant on fastening down the chairs were removed. The chairs had been fastened with bolts and screws, but he had found that on the slightest loosening the bolt-heads flew off, from the continual percussions, and the screws very soon allowed vertical play, from the yielding of the fibre of the wood. By Evans's rail, we secured the rail without the intervention of the fibre of the wood. One inconvenience attending it was, the trouble of scraping away the earth to tighten the nuts when necessary; but this might be partially remedied by placing the bolts as often as possible in the transverse gutters for draining the road, by which at least one-half the bolts might be easily got at; and the difficulty of tightening the remaining bolts would be lessened, if, as he recommended, the timbers were left uncovered. He preferred thus giving a free circulation of air, and disliked burying the sleepers in ballast. The weight of Evans's rail was only 45lb. per yard, although quite strong enough, while the other was 100lb. The bevel in No. 2 rail might be given in the wood-bearing; in No. 1 it was caused by the casting of the chair; this latter rail, from having its top and bottom sides alike, had this advantage, that when it began to wear it might be turned round, or even turned upside down, which was a very great advantage. He had for many years advocated wooden sleepers *versus* stone, from his ex-

perience on the Dublin and Kingstown Railway, where he found that the granite sleepers, the more massive they were the more injurious to the rails and carriages. These had all been taken up, and wooden sleepers laid down, and the saving in expense of repairs would in a few years reimburse the outlay. The railway costs now only 50*l.* per mile per annum for repairs, notwithstanding the great traffic over it. The rails were the old 42lb. rails, and, nevertheless, were still used, in consequence of the advantage gained by the wooden sleepers. He recommended keeping Evans's rail to the gauge by light iron rods passed through holes in the rails, and secured by nuts: he thought these transverse ties should never be used as supports.

*Mr. Bucke* remarked, that the rails on the North Union had already been so worn as to require turning. The section of Evans's rails was bad, as, from the squareness of the top, the wheel would not bear on the centre of the rail. He had used these rails a little himself, and had no objection to them for light work. He had remedied the form of rail on the Manchester and Birmingham Railway, so as to give the wheels a bearing on the centre of the rail. He conceived a great disadvantage in the longitudinal continuous bearing was, that the foundation was so near the surface; the stability of the foundation was as the square of the depth, and therefore the necessarily narrow foundation of the continuous bearing was rendered still weaker by its proximity to the surface, and the plan of laying down a railway "like a ladder on the ground," had failed where it had been tried. —Prof. Vignoles considered that the failure to which Mr. Bucke alluded, was from making the transverse ties too strong.—*From the Athenæum.*

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THE CASE IN LIFE ASSURANCE—(P. 95).

*Solution.*

Sir,—I send you a solution of Iver M'Iver's question on Life Annuities.

First let us suppose the rate of interest to be 3 per cent.

The number living at the age of 23 by the Northampton Tables is 4910, and at 43, 3404 : : 4910 : 3404 : : 100 : 69·33; that is, 69·33 will be the probable number alive at the end of 20 years, and 69·33 × 100 = £6933 will be the probable sum to be divided among the survivors at the end of 20 years.

The next thing to be done is to compute the value of an annuity of £1 on the life of a person aged 23 for 10 years. This will be effected from the fundamental theorem

$$P^1 = \frac{1}{a}\left(\frac{b}{R} + \frac{c}{R^2} + \frac{d}{R^3} + \frac{e}{R^4} + \&c.\right)$$

where $a = 4910$, $b = 4835$, $c = 4760$, &c., and $R = 1·03$.

$$\frac{b}{R} = 4835 + 1·030000 = 4694·175$$
$$\frac{c}{R^2} = 4760 + 1·060900 = 4486·757$$
$$\frac{d}{R^3} = 4685 + 1·092727 = 4287·439$$
$$\frac{e}{R^4} = 4610 + 1·125508 = 4095·928$$
$$\frac{f}{R^5} = 4535 + 1·159274 = 3911·931$$
$$\frac{g}{R^6} = 4460 + 1·194052 = 3735·181$$
$$\frac{h}{R^7} = 4385 + 1·229873 = 3565·409$$
$$\frac{i}{R^8} = 4310 + 1·246770 = 3402·354$$
$$\frac{k}{R^9} = 4235 \div 1·304773 = 3245·775$$
$$35424·949$$

and $P^1 = 35424·949 + 4910 = 7·21486$. Hence, $P = 7·21486 + 1 = 8·21486$ is the present value of an annuity of £1 for 10 years for an age of 23, the first premium being paid in advance.

[We have made another computation from a formula given in a former Number of the Magazine, and it is exactly the same as the above.]

Let $x$ = required annual premium, $8·21486 = P$. Then $100 \times P \times R^{10} \times x x$ will be the probable amount of all the premiums when insured at compound interest for 10 years, and if this sum be improved for 10 years more, it will be $100 \times P \times R^{20} \times x x$, and on the supposition of an equality of probabilities, the said sum should be £6933. Hence,

$$100 \times P \times R^{20} \times x = 6933$$
$$x = \frac{6933}{110 \times P \times R^{20}}$$
$$= \frac{6933}{821·486 \times 1·806111} = £4,673$$

£4 13*s.* 5¼*d.*, the required annual premium.

By a like process of calculation, the annual premium, when the value of interest is 4 per cent., will be £4 0*s.* 1¼*d.*

It may be here remarked, that the Northampton Tables of the duration of life are not at all adapted to Iver M'Iver's question, and if practically acted upon would prove ruinous to the proprietary, whether the interest be 3 or 4 per cent. For it is now universally admitted, that the Northampton Tables of the duration of life make the waste of life much greater than facts warrant. Such tables, however, have a tendency to produce great profits to the proprietary of an Assurance Office in the ordinary cases for insuring lives for any given sum and period, or for the whole duration of life. But those Tables that produce great profit to the proprietary in this mode of assurance, will be found to produce an exactly contrary effect in the application of the scheme proposed by Iver M'Iver; or in other words, if the annual premiums were computed from more healthy tables than the Northampton, then the said premiums would be found to be much higher than those deduced from the Northampton Tables. But this, Mr. Editor, as well as some other calculations required by your correspondent, I will make the subject of another communication.

I am, Mr. Editor, yours, &c.
GEORGE SCOTT.

Cochrane Terrace, St. John's Wood.

THE CASE IN LIFE ASSURANCE—ANOTHER SOLUTION.

Sir,—Whatever may be the qualifications and acquirements, in other respects, of your old correspondent Iver M'Iver, it is pretty clear that he is but a tyro in the matter of Life Assurance. Were he otherwise, he would hardly have called the attention of your readers to a question so very simple as that contained in page 95 of your present volume, or trammelled it, as he has done, with conditions which have nothing whatever to do with its solution.

Thus, he says—" *One hundred* individuals, each of the ages of twenty-three, subscribe annually for ten years a sufficient sum each to enable the survivors to receive each 100*l*. at the end of twenty years." And then he asks, how much should this annual payment be, according to " the Northampton or any other tables of probabilities?" Now on this I remark, first, that it is of no consequence whether the number of assured be a hundred or a hundred thousand, since the solution of all such questions proceeds on the supposition that the mortality to be experienced will be precisely in proportion to that indicated in the table which is assumed as the basis of the calculation. Seventy thousand survivors out of a hundred thousand will give the same result as seventy out of a hundred. Secondly, he wishes the result according to the Northampton " or any other table." Does he not know that each table will give a different result? Or does he wish the result according to all the known tables, such as the Carlisle, the Chester, (male and female) the Government (male and female), the Equitable, the Amicable, the Swedish, &c. &c.? Could he not have contented himself with specifying *one* table, and then an answer according to his wishes could have been given.

Lastly, he desires to know what the annual premium would be, " *supposing the proprietary to receive one-third of the profits?*" Here your correspondent betrays his ignorance most of all. Does he not know that the very principle on which the solution of all cases of life assurance and annuities proceeds, is, that there will be no profit on either side; that the present and prospective payments of the assured will be an exact compensation for the prospective payments of the assurers? If Iver M'Iver will first tell us what addition is to be made to the premium in name of profit or commission (a practice almost universally followed by the offices to pay expenses, and guard against fluctuations), or inform us of the deviation which is to take place in the mortality of his hundred individuals, from that indicated in the table which we are to take for our guidance, then, but not before, we shall be able to gratify him. The question, divested of what does not belong to it, is as follows:—Required the annual premium, payable ten times in all, the first payment to be made immediately, subject to the failure of the life, to entitle an individual, now aged 23, to 100*l*. on his attaining the age of 43, interest being reckoned at three per cent., and the rate of mortality according to the Northampton Tables.

I shall solve this question without reference to the doctrine of probability. By the Northampton table 3,404 is the

number who, out of 4,910, alive at 23, attain the age of 43; 3,404*l*., therefore, is the sum which will have to be provided to pay each of the survivors one pound twenty years hence. But since money bears interest at the rate of three per cent., the present value of one pound to be received twenty years hence is

$$\frac{1}{1{\cdot}03^{20}} = {\cdot}553676.$$

Therefore the present value of 3,404*l*. to be received twenty years hence is

$$3{,}404 \times {\cdot}553676 = 1{,}884{\cdot}713104,$$

and this is the sum which would have to be paid now to provide one pound for each of the survivors at the age of 43. Moreover, as the 4,910 individuals all contribute equally, the division of this sum by the number of contributors gives ·383852, the present contribution of each. And, finally, multiplying this by 100, we have 38·3852=38*l*. 7*s*. 8½*d*. for the sum to be paid down now by an individual aged 23, to secure 100*l*. on his attaining the age of 43.

But this benefit is to be purchased, not by a single payment, but by an annual premium for ten years, of which the first payment is to be made immediately; that is, by a temporary annuity upon the life of the individual for *nine* years, together with a present payment of that annuity. First, let us find the value of an annuity of 1*l*. paid in this way. To do this we must find the present value of an annuity of 1*l*. deferred for the same number of years. This value is equal to the value of a life annuity at the advanced age, that is at 32, multiplied by the number alive by the table at that age, and by the present value of one pound due at the end of the period of deferment, and the product divided by the number alive at the present age. Taking the numbers indicated from the tables, we have

$$\frac{16{\cdot}5398 \times 4235 \times {\cdot}766417}{4910} = 10{\cdot}9337$$

Now since the sum of the present values of an annuity deferred for nine years, and of an annuity to continue nine years, is evidently equal to the present value of a life annuity; therefore, taking the value of the life annuity at age 23 from the table, and subtracting from it the value just found, we have

$$18{\cdot}1486 - 10{\cdot}9337 = 7{\cdot}2149$$

which is the value of a temporary annuity of one pound upon a life now aged 23. To this adding the present payment, or one pound, we have 8·2149 for the present value of an annual premium of 1*l*. to be paid for ten years by an individual now aged 23. Hence by a simple proportion we find the premium of which we are in search. The present value of a premium of 1*l*., is to the present value of any other premium, as 1*l*. to that other premium:

8·2149 : 38·3852 : : 1 : 4·6727 =

£4 13*s*. 6*d*. = the required premium.

I have been perhaps more lengthy than was necessary in the foregoing solution; but to this, Mr. Editor, I dare say those of your readers who are less familiar with the subject will not object. Had the logarithmic method of computation been employed, and the figures only been exhibited, the solution would have been much briefer.

The best and simplest method of solving all questions relating to life contingencies, (and the shortest, withal) is by means of tables of a certain construction, of which a copious collection is contained in Mr. Jones's "Treatise on Annuities," in the "Library of Useful Knowledge." Mr. Jones calls the tables alluded to, *Preparatory Tables*; but Professor De Morgan, who is the writer of two able articles in the *Companion to the Almanac*, for 1840 and 1842, explanatory of their construction and applications, (which articles, I fear, are not so well known as they deserve to be,) calls them, with, as it seems to me, more propriety, *Commutation Tables*.

As an example of the application of the tables I have referred to, I shall, with your leave, Mr. Editor, give a solution according to them, of the problem I have solved above in the usual way. I must premise that the tables consist of various columns headed D, N, S, &c., respectively; and that the number in any column, opposite any age, is denoted by the letter at the head of the column, with the age appended to it, either as a suffix, or enclosed in brackets. I shall adopt the latter mode, for the convenience of your compositors.

Let the present age be $x$, the sum assured $s$, the number of years to elapse before the sum assured becomes payable $n$, and the annual premium, payable $l$, times $p$.

Then will the present value of the assurance be $\frac{s\,D(x+n)}{D(x)}$; and the present value of the premium

$$\frac{p\,[N(x-1)-N(x+l-1)]}{D(x)}.$$

Therefore, since by condition these values must be equal to each other, we have

$$p\,[N(x-1)-N(x+l-1)] = s\,D(x+n).$$

Whence $p = \frac{s\,D(x+n)}{N(x-1)-N(x+l-1)}$

This is a general solution, applicable to any age, any period of deferment, any sum assured, any number of premiums, and any table of mortality and rate of interest for which commutation tables have been calculated. To apply the formula to the case before us, restore the values of $x$, $n$, $s$, $l$, and it becomes

$$p = \frac{100\,D(43)}{N(22)-N(32)};$$

and taking the numbers from the Northampton 3 per cent. Table in Jones, (p. 242,) we have finally—

$$p = \frac{95496\cdot8}{47638.882-27201\cdot501} = \frac{95496\cdot8}{20437\cdot381} = 4\cdot6727 =$$

£4 13*s.* 6*d.* as before.

The answers by the Carlisle table, at 3 and at 4 per cent., found as above, are respectively 5*l.* 6*s.* 4*d.* and 4*l.* 11*s.* 3*d.* When I mention that the finding of each of these values was the work of less than five minutes, the superiority of this mode of operation will be apparent.

I am, Mr. Editor, &c., G.

Hermes-street, Pentonville, July 25, 1842.

## MR. VALLANCE ON THE NIGER EXPEDITION, AND HIS PNEUMATIC RAILWAY.

Sir,—An error of your printer, which makes my letter to Captain Trotter, R.N. (the copy of which is given in last week's number of your Magazine) appear as if it had been written only a month instead of two years ago, renders it necessary that I should solicit the favour of your stating that it was sent *in June* 1840, instead of the present year.

Being compelled thus to trouble you, I take advantage of the opportunity to ask the additional favour of your inserting the subjoined paragraphs from a paper which I wrote six years ago, in order to counteract an erroneous statement, and what I deem an erroneous opinion of Colonel Macerone's. That gentleman states that "the passengers had no other light than that of lamps" in my pneumatic railway; and that he considers "*super-terraneous*" conveyance the best. The reasons assigned in the subjoined paragraphs render me of a different opinion.

I am aware that I stand alone in this belief. But as it is the result of the conviction which makes me unwilling (*not* unable) to bring forward any method of going above ground, such as Messrs. Medhurst, Pinkus, and Clegg have published, all of which I believe myself prepared to prove, may be superseded by better methods being made practicable. I am unwavering in the preference which, for so many years, I have given it; and am willing to risk any little reputation that I may ever obtain, on the opinion, that conveyance *inside* the tunnels of pneumatic railways will, eventually, supersede conveyance in the open air, because it will be cheaper (in first cost, as well as current expenses), quicker, and safer: while, in contrast with common railways and locomotive engines, I can show that it will be *several* times cheaper, in point of both first cost and current expenses; incomparably safer; and so much quicker, that *few* as are the hours required for conveying us a hundred miles by means of them, the public will, by and by (*ere long, indeed*) say as to those few hours, what Lear's daughters said of his knights.

I appeal to time as the umpire on these points; though one of my reasons for holding this opinion may be inferred from the table which follows the subjoined paragraphs, which I ask the favour of your inserting; which table was published in the same paper in which those paragraphs appeared, and applies to all carriages in the open air, be the means of traction what they may.

Wishing success to Messrs. Clegg and Samuda's application of the principle to the Dublin and Kingstown railway as interestedly as, and—for reasons which are stated in the second scene of the third act of King Henry the Fourth—more *anxiously* than, they themselves desire it.

I have the honour to be,

Sir, your most obedient servant,

JOHN VALLANCE.

16, Brook-street, West-square, 25th July 1842.

### THE OBJECTION TO TRAVELLING INSIDE PNEUMATIC RAILWAY TUNNELS CONSIDERED.

Nor would the objection which, it may be imagined, must arise from the want of daylight in the tunnel, prove an objection in point of fact. For, but that the advantages which would arise from saving expense in the purchase of ground, and obviation of objections on the part of landowners prevent it, I could window-light the tunnel throughout its whole length: that which I constructed at Brighton having light admitted into it through windows of common thin glass; strong plate glass not being required. Indeed, so far as relates to possibility, the upper half of the tunnel might be one continued window (like the top of a greenhouse) throughout its whole length. But as, even if this were done, artificial light *must* be had for sixteen hours out of the twenty-four in winter; as the tunnel might be gas-lighted throughout its whole length; or as, instead of thus wasting light unnecessarily, each carriage might carry lights before and behind, the objection that the tunnel being underground would render it dark as midnight, is no more a *serious* objection than it would be, were the Thames Tunnel finished, that it would be better to cross the river by London Bridge than through that tunnel, because on the bridge you would have *natural*, while in the tunnel you must have artificial light.

It is true that there could be no "view of the country" by this method of travelling. But as the object of it is the *perfection* of conveyance, in the three particulars of safety, expedition, and economy; as even the comparatively low rates attained on the Liverpool and Manchester Railway prevent objects that are by the road-side being distinctly seen, owing to the velocity with which the passengers are whirled by them; and as the much greater velocity at which conveyance may be effected in the tunnel would render any attempt to look on what was *passed* productive of the effects experienced by a child who looks on the ground while leaning out of the window of a coach, no *real* loss as relates to "seeing the country," would result from transmission taking place inside, instead of outside the tunnel: though even if it should, it might be submitted to when economy of both time and money, and complete obviation of the dangers attendant on breaking down, being overturned, run away with, or driven against anything, became the equivalents.

Have we occasion to travel to Edinburgh by the mail, we unrepiningly submit to the inconvenience of passing two nights (thirty-two hours in mid-winter) not only in total darkness, but also "cabinned, cribbed, confined," to a degree which prevents us even from "changing a leg," except by previous arrangement with our opposite fellow-passenger. But when it is proposed that we shall go in vehicles which, in addition to being as large and commodious as the cabins of many steam-vessels, will be as much shorter a time in going, as they are larger and more convenient than the inside of mail-coaches, and in which the most brilliant light may be enjoyed, we proclaim it to be "impossible" to consent to go by such vehicles, because they would move inside a tunnel: not considering that this very circumstance of being *inside* said tunnel, would as certainly secure us from being overturned, driven against anything, run away with, breaking down, or any other of the dangers to which turnpike-road or railway travelling is liable, as it would give us the ease, comfort, and accommodation of the cabin of a steam-vessel, instead of the privations and endurances experienced in mail-coaches. As truly as—nay *more* truly than Hotspur says, "But I tell you, my lord fool, out of this nettle danger, we pluck this flower safety," may I say, from this bugbear *darkness* would spring *perfect* immunity from danger.

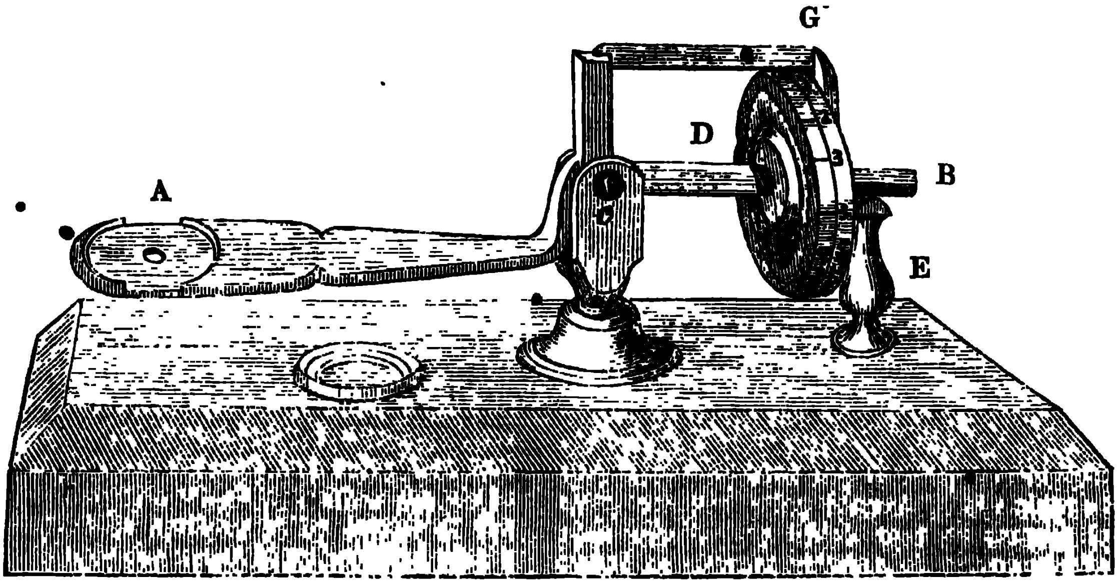
THE TABLE.

| Locomotive engines (drawing *no* load) moving through still air, at the under-stated velocities. | | Experience resistances from that air, equal (roundly) to the under-stated number of lbs. | | Which resistances, having to be overcome at the rates of the first-stated number of feet per second, require power equal to that of the under-stated number of horses, to overcome them. |
|---|---|---|---|---|
| Feet per second. | Miles per hour. | Per square foot. | On 40 square feet. | |
| 14.666 | 10 | 0½ | 20 | 0½ |
| 29.332 | 20 | 2. | 80 | 4¼ |
| 44. | 30 | 4.5 | 180 | 14¼ |
| 58.666 | 40 | 8.0 | 320 | 33¾ |
| 73.333 | 50 | 12.5 | 500 | 66 |
| 88. | 60 | 18.0 | 720 | 114 |
| 117.328 | 80 | 32.0 | 1280 | 270 |
| 146.666 | 100 | 50.0 | 2000 | 528 |
| 176. | 120 | 72.0 | 2880 | 912 |

Now as a velocity of 40 miles an hour requires power nearly equal to that of the largest locomotives which have yet been made, and as Dr. Hutton found that giving the moving body a point in the shape of a cone, the height of which was equal to the diameter of its base, diminished the resistance of the air only half, there hence (and without adverting to the additional resistance which *must* be created by the tenders of, and trains drawn by the engines) arises a very sufficient explanation why no greater velocity has been attained by the (nearly) ten times more powerful locomotive engines now made, than was first attained by those which ran at the rate of 35 miles an hour on the Liverpool and Manchester Railway in October 1829.

## KERSHAW'S MICROMETER BALANCE.

(Registered pursuant to Act of Parliament.)




Sir,—When the recent alteration took place in our postage, of charging letters by weight, a great deal of ingenuity was exercised in devising balances suitable for that particular purpose; several of these, displaying considerable skill and fitness in their arrangement, were fully described at the time in your pages.

The late "sovereign panic" has shown, however, that numerous as were the dabblers in balances on the former occasion, the subject is not yet exhausted: several novelties having been produced, capable of satisfactorily indicating the minute deficiencies which wear and tear have produced on the gold coins of the country. I say *minute*, because the actual average deficiency is only from a grain to a grain and a half; each grain being worth 2*d*. Stories have been rife about the "plugging" and "sweating" of our coins by "Jews" and "foreigners," but with very little foundation; the deficiencies would seem really to arise from the fair wear of continuous circulation.

Many of your readers are doubtless familiar with the "Adventures of a Guinea," but could one of our poor debased and degraded sovereigns describe the millions of rapid "changes" which it had undergone, between its issue from the Mint in the reign of the Sailor King, or the fourth of the Georges, or it may be, in that of his venerable predecessor, the wonder would be, that the actual deficiency should in so many cases be under half a grain.

The policy of throwing the loss on the holders of the deteriorated currency may be questioned: not so much as regards the actual deficiency, which is but small, but as opening the door to the most extensive frauds—arising in some cases from sheer ignorance, in others from absolute knavery, by which the poorer classes have been robbed of from ninepence to fifteen pence, and even more in the pound.*

A larger portion of the mischief was incurred before there was any possibility

* In some few instances as much as *half-a-crown*, and even *three and sixpence* have been deducted from a "light sovereign."

of obtaining in sufficient abundance the means of ascertaining the weight of the coinage; this want, however, has been promptly met, and among other *sovereign* remedies, a balance (invented by Mr. W. Armstead) brought out by Mr. Kershaw, of Wilderness-row, is deserving of especial notice, alike for its ingenuity and power.

This instrument, which has been appropriately named the "Micrometer Balance," is represented in the prefixed sketch. It consists of a beam or steel-yard A B, supported on a knife-edged fulcrum at *c;* about midway on the cylindrical portion of the beam (B) a few threads of a screw are cut, upon which a micrometer wheel D, tapped to correspond, turns freely; the rim or periphery of this wheel is divided into half grains, each of which extends over a space equal to one quarter of an inch.* When at rest, the end of the beam B rests upon a pillar or supporter E.

To use this balance, the micrometer wheel is turned back towards B, until the zero, or full-weight mark, is immediately under the index bar G. If the coin is deficient, the wheel is turned forward until equilibrium is obtained, when the value of the actual deficiency will be shown in pence by the figures on the periphery of the wheel. When half-sovereigns are to be tested, the supplemental weight *f* is employed, when the deficiency will be indicated as before.

By this balance the use of small weights and the necessity of calculations are entirely obviated, and the ease with which the deficiency in the value of the coin can be detected must recommend it to all persons having money passing through their hands.

This method of ascertaining in a distinct and tangible manner very minute differences of weight is both ingenious and useful, and will very soon be applied to balances for several other purposes for which it seems to be peculiarly eligible.

The greater portion of the "light gold" has by this time been put out of circulation; but there is reason to believe that a good deal is still in reserve, to be passed current when the present excitement has subsided. Besides which, the ordinary wear will be going on, (to say nothing of wilful deterioration,) and therefore men of business will always require a ready means at hand for ascertaining the real value of the coins which are presented to them; and for this purpose I fancy few contrivances are better adapted than "Kershaw's micrometer balance."

I remain, Sir,

Yours respectfully,

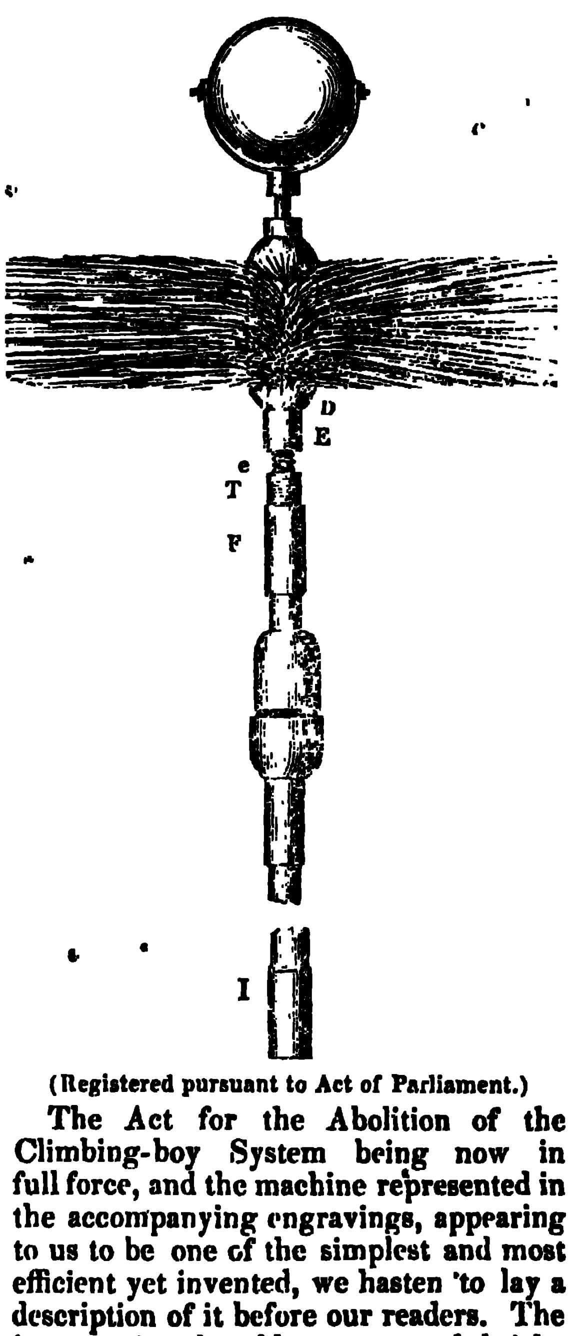
WILLIAM BADDELEY.

29, Alfred-street, Islington. July 21st, 1842.

* By increasing the diameter and diminishing the thickness of the wheel, a still larger indication can of course be obtained.

## CRAVEN'S UNIVERSAL JOINTED SWEEPING MACHINE.

Fig. 1.




(Registered pursuant to Act of Parliament.)

The Act for the Abolition of the Climbing-boy System being now in full force, and the machine represented in the accompanying engravings, appearing to us to be one of the simplest and most efficient yet invented, we hasten to lay a description of it before our readers. The inventor is a humble mason and brick-

layer, of Sheffield, (Court No. 2, Hermitage-street,) and has, we presume, made arrangements for executing any orders with which he may be favoured.

Fig. 1 is an elevation of the machine, and fig. 2 a sectional view. Fig. 3 represents the machine as at work, and in the act of turning a right angle in a flue of nine inches in width, which is, we believe, one of the worst possible form and size, that a machine can ever be expected to have to work up.

Fig. 2.

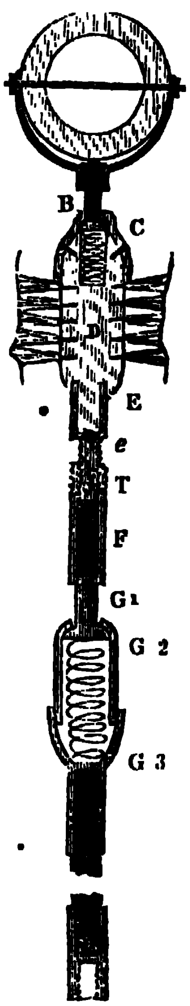



Fig. 3.

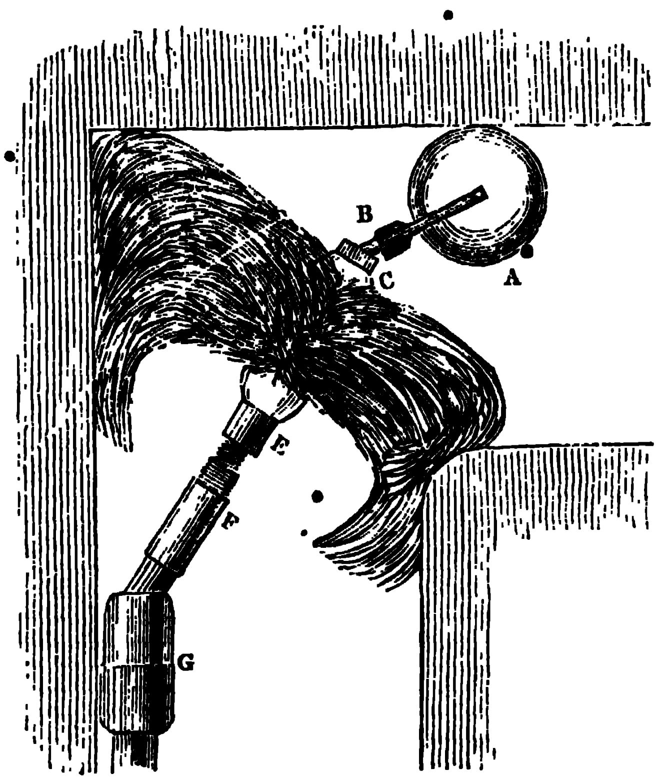
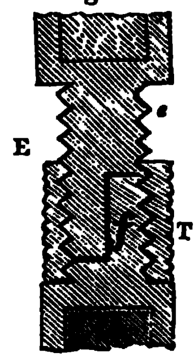



Fig. 4.




A is a guide-ball, of wood, which forms the top of the machine, made hollow for the sake of lightness, and so hung as to turn completely round on an iron rod B. The iron rod B is inserted into a brass box C, and so connected, as to revolve round and bend in any direction. A spring is placed in the box C, which causes the rod B, when there is no pressure upon it, to return to its vertical position. D is the brush-head, made of wood, into which is inserted all round five rows of whalebone. E is a brass socket, into which the lower end of the brush-head is fixed, and from the bottom of which projects a screw, *e*, which, for about one-third of its length at the lower end, has ½ in the vertical direction cut away, as shown separately on an enlarged scale in fig. 4. F is another socket, with the hollow part the reverse way of that of E, from the top of which projects a screw of a similar description with the last, so that the two half-ends, *e f*, meet and fit each other exactly. T is a thimble, with threads inside corresponding to those of the screws, which is brought over the two half-ends, and connects them firmly together. $G^1$ is a piece which is inserted at one end into the socket F, and at the other is shaped like B, and connected in the same manner as that is, with a brass box and spring $G^2$, so as also to revolve round and bend in any direction. $G^3$ is an under piece, which screws on to $G^2$, and terminates in a socket, into which the cane piece H is fixed by a screw, in the manner represented in fig. 2. Where a number of cane pieces are required, they may be either jointed in the ordi-

nary way, or by screws and thimbles, like those before described, (*e f* T.)

The superiority of this machine, in several respects, is very evident. The guide-ball, in ascending a flue, by revolving in any direction, is enabled to pass easily over any irregularities or projections, and its universal joint allows it to turn much sharper angles than what a common machine can do. Again, the universal joint at $G^1$, $G^2$, $G^3$, brings the cane, or series of canes, readily into work; while the new screw joint, (a contrivance of great ingenuity, and applicable to many other purposes besides the present,) effectually excludes all risk of the brush being detached from the other parts of the machine, as happens but too frequently with Glass's, and other machines.

From a number of well-authenticated experiments, made at Sheffield with this apparatus, it appears to require only about one-half the power of those in common use.

## THE WATER SUPPLY OF THE METROPOLIS, AND MR. STUCKEY'S PLAN OF FILTRATION.

We have been favoured with a copy of a petition which, we are glad to find, was presented on Monday last to the House of Commons, by that zealous friend of all public improvements, Major-General Sir Frederick Trench, from Mr. Stuckey, the inventor of the new system of filtration which has been recently the subject of several interesting communications in our journal.

The petition, after reciting the different parliamentary inquiries which were instituted into the subject of purifying the water of the metropolis in 1821, 1828, and 1834, states that, from the evidence elicited by these inquiries, it appeared—

"That *Filtration* as then carried on (and as it is still carried on), was most dilatory in its process, and most expensive in its results:—that it had ruined one great Water Company in the City of Glasgow:—that it had entailed a cost of fifteen per cent. upon the rental of the Chelsea Water-works Company:—that it would take £19,000 per annum, or double the per-centage of the Chelsea Company, to filter the water of the New River Company:—that the charge estimated by the Engineer of the East London Water-works Company, was no less than 11¼ per cent. upon the rental of that Company, (the greatest part of the water of which was used for manufacturing purposes,) and most of those Companies, with many others, though strongly urged by Committees of your Honourable House, by public opinion, and by the acknowledged inferiority of the supply in its unfiltered state, have, refused, and up to the present hour continue to refuse to filter their water, on the ground of the dilatoriness of the process, and the enormity of the expense."

The Petitioner further avers "that seeing the necessity of filtration, though declining to do it themselves, many of those Water Companies have urged, that their customers possess private filters, and that such private filters, by filtering the water wanted only for domestic purposes, might more economically purify the water necessary to be purified, than those Companies could do it for them:—but, that such small filters, by the slowness of their process, destroy the carbonic acid gas which is contained in the water, and without which it speedily becomes offensive, putrid, and injurious to health; but, that by the filter he has invented, the carbonic acid gas is retained in the water; and moreover, that by the present system of filtration, it requires large quantities of ground to be set apart for filtering beds, which have frequently to be cleaned, at great expense, attended with malaria, often fatal in its results:—whereas, by the petitioner's process of filtration, one foot will do the work of one acre of such filtering beds, without the necessity of frequent periodical cleansings, and without the possibility of dangerous malaria."

The petitioner sums up the advantages of his invention over the present system of filtration, in these words:

"It presents an economy in SPACE of one foot for one acre: of MONEY, of £7,300 per annum as the current expenses, instead of the estimated current expenses of the New River Company of £19,000 per annum; and in TIME, of filtering in 6 hours by machinery of one foot to the acre, more than two millions, three hundred thousand gallons, which quantity, in the Chelsea water-works, it takes twenty-four hours to filter."

The petitioner concludes with the mention of a personal circumstance highly honourable to Mr. Stuckey, who though descended of English parents, was, it appears, born in Russia.

"The petitioner has no wish either to manufacture, or to receive any profit upon the manufacturing of his machines, but on his return to his native country (Russia), will be perfectly satisfied by the adoption by the land of his fathers of this valuable invention, upon any terms its legislature may think proper.

"The petitioner has not taken out a pa-

tent for his invention for filtration, considering that a manner of such vast importance to millions of his fellow-creatures should not be limited in its operation by the exactions of monopoly, or the avarice of that inhumanity which would refuse the blessing of pure water to all who would not, or could not, enrich the discoverer of such an invention."

The prayer of the petition is, for an inquiry into the truth of its allegations, and should such inquiry terminate to the satisfaction of the House, that they will "take means to provide for the universal adoption of filtration, upon the petitioner's plan, for the benefit of the hundreds of thousands of families who have petitioned the House for pure water."

## ABSTRACTS OF SPECIFICATIONS OF ENGLISH PATENTS RECENTLY ENROLLED.

JAMES COLE, OF NO. 2, YOUL'S PLACE, OLD KENT-ROAD, IN THE COUNTY OF SURREY, BRUSH MANUFACTURER, *for certain improvements in the construction of brushes.*—Enrolment Office, July 15, 1842.

The usual modes of making brushes and brooms are technically called *pan* and *drawing*. According to the first of these modes the bristles are set into the wood by means of pitch, cement, or glue, (generally pitch) kept in a heated state in a pan over a charcoal fire; while, according to the second mode, they are drawn into the wood by being passed into a loop of wire which tightens as it is pulled, until the bristles get firmly fixed in the hole; after which, the wire is passed through the next hole, a loop made for the bristles, and so on, until the brush is complete. In the former case, it is the pitch, cement, or glue, that holds the bristles fast; in the other case it is the wire.

The first of the present patented improvements consists in securing the bristles independently of the pitch or wire. In explaining how this is accomplished, Mr. Cole treats of the operation under three heads; first, the boring of the holes; second, the making of the knots of bristles; and third, the inserting of the knots. *First*, then, of the boring of the holes. The hole made for pan-work is only a semicircular excavation in the solid face of the wood. In drawn work there is a similar hole with a smaller one from the bottom of it right through the wood. For his improved method, Mr. Cole adopts the drawn work hole inverted, but with a less disproportion between the two orifices. As in drawn work in certain cases, a taper hole made with one bit answers, instead of making the two holes by separate operations; so also in his method, one bit cutting a taper hole, will, in many instances, answer instead of using two bits. The main distinction, however, between the hole, Mr. Cole adopts in his new plan, and that common to drawn work is, that he uses the hole in an inverted position. In drawn work the largest part of the hole is on the face of the brush, while in brushes of his improved description, the largest part is at the back of the brush. *Secondly*, of making the knots of bristles. A knot is the technical term for the quantity of bristles with which each hole is filled. In drawn work the knot is formed by the action of the wire and held in by it. In pan work the knot is formed by taking as many bristles as will fill the hole, and dipping the root ends into melted pitch, cement, or glue, to the depth of ⅜th or ⅝th of an inch. The superfluous pitch, cement, or glue, is then cleared off by drawing the knot over a thin edge of metal, called a striker, and the bristles thus cleared are all bound together by a piece of thrum, or hemp, being wound tight round the part which has been so dipped. In the same manner as that last described, Mr. Cole makes the knots for his improved construction of brushes. But, *thirdly*, as regards the insertion of the knots into the wood: according to the method ordinarily followed in pan-work, when the knot has been dipped and bound together in the manner just explained, it is dipped a second time into the pitch, cement, or glue, and with all the pitch, cement, or glue, which adheres to it, is immediately inserted in the hole; the pitch, glue, or cement used, being the only thing that attaches the knot of bristles to the wood. Now, Mr. Cole's improvement as regards this part of the operation, consists in not dipping the knot a second time, but binding the whole of the bristles together by winding a piece of thread loosely round them from the root upwards to the flag, and then passing the knot so wound up, flag foremost, through the hole at the back part and pulling it through, until the part pitched and bound together fills the cavity prepared for it. He then pulls out the loose thread, which was only put on for the convenience of passing the knot through the hole easily and speedily. A knot secured in this manner cannot afterwards be pulled out without breaking the wood that holds it together. But, as there is nothing in the form of the hole to prevent it from being pushed back again, in order to guard against this—after all the holes in the brush have been filled in the manner before described, the patentee takes a red hot iron and burns away all irregularities of pitch, bristle, or thrum, to a level with the wood in which they are inserted, and then affixes to the sur-

face so levelled, a back of wood or other material, nailed, glued, screwed, or otherwise fastened to it, by which backing, any pushing back of the knot is effectually prevented. By this his first improved mode of construction, he combines the two advantages which separately distinguish the pan and drawing methods, and is able to make brushes of a more effective and durable character than can be made by either.

A *second* improvement consists in subjecting the string with which brushes are tied to a previous preparation, whereby the bursting so much complained of when brushes are laid in water, to prevent the paint on them from hardening, is effectually prevented. The composition which he uses is made as follows:—To the article known in commerce by the name of the "British American fluid," he adds as much caoutchouc in solution as it will take up or combine with. The fluid is slow in taking up the caoutchouc, and he states that he has not not been able in any of his experiments to saturate it completely until the mixture has stood five or six days. When thus prepared, he immerses the string in the preparation and leaves it in, long enough for it to become saturated with it. He then draws it out, clears it of the superfluous fluid and dries it.

A *third* improvement relates to that class of brushes in which the handle is inserted in the form of a wedge as in the painting brush, tar brush, dusting brush and others. The handle is the only stay for brushes so made, and from the nature of the wedge it is plain that the least relaxation from the tightness imparted by the last drive of the hammer endangers the whole brush. There is a moisture in bristles which long exposure to a warm atmosphere dries up, and it is a matter of every-day occurrence that through this drying up, the handles of brushes so made, get loose and the brushes fall to pieces. To remedy this, Mr. Cole adopts the following means:—After the brush is made in the usual manner, he submits it to an artificial heat, to shrink the bristles as much as possible. He then takes a square staple of metal as wide as the thickest part of the wedge handle, and with prongs as long as the binding on the brush, and drives these prongs through the body of bristle that has been shrunk, until the bar of the staple rests upon the top of the wedge, and the points of the prongs appear through the bristles at their roots, or in other words at the back of the brush. He then takes a thin plate of metal of the same size as the back of the brush, having a hole in the centre sufficient to enable it to pass freely down the handle, and having also holes for the reception of the prongs of the staple; and having passed this plate on to the handle and prongs, he secures it to the staple by soldering or rivetting. The bristles being thus artificially shrunk, and the laxity thus produced being made good by the prongs of the staple passing through them, the brush is rendered extremely tight, and the staple crossing the top of the wedge, and being secured by its prongs to the plate at the back, keeps the brush so; because the staple so confined cannot slide back from its position, nor can it allow the wedge to do so in the least degree.

A *fourth* improvement consists in constructing in the following manner brushes of plush for cleaning ladies' garments and other slight fabrics, the texture of which might be injured by the friction of bristles. The patentee takes a piece of plush of any convenient length and width (say 6¾ in. long and 6 in. wide) and forms it into a cylinder having the grain of the plush running round it. It is then closed at one end, and white flock or other suitable material is stuffed into it. When thus stuffed the upper end is closed after the same manner as the lower end. To hide the gatherings at the ends, the patentee covers button-moulds of a convenient size with silk or other material, and affixes one at each end of the brush.

A *fifth* improvement consists in making brushes or pencils of spun glass, by which aqua fortis and other corrosive acids can be applied by silversmiths and jewellers with more delicacy and safety in testing metals, than by any of the usual means, and which can also be made available for many useful purposes in chemistry and the arts. One form in which he make brushes of this sort resembles, in some respects, the well-known camel-hair pencil; but instead of the quill there employed, he makes use of glass tubes, preferring to have them tapering off in diameter at the end designed for the brush. The spun glass being cut into convenient lengths, he passes a knot or bunch of it down the tube, until it comes out of a convenient length at the other end. If the tube is well filled and a good length of the knot is left inside, no additional fastening will be required; but for the sake of greater certainty, that portion of the tube which immediately surrounds the knot of glass may be softened by means of the blow-pipe and then compressed and elongated a little, so as to tighten upon the spun glass, taking care not to allow the flame of the blow-pipe to touch the spun glass, which would be fused or injured by it. Another mode of securing the spun glass, is to make use of a tube of a tapering form, and drawing the spun glass through the smaller end. till it can be drawn no further, then to plug up the vacant

part of the tube with wood, or other suitable substance. Instead also of the brushes being circular, they may be made flat, and the spun glass be secured within flat tubes or between flat plates of glass, placed either parallel to each other or at any suitable angle, and closed at the ends by the blowpipe or any other suitable means.

A *sixth* improvement relates to brushes for cleaning decanters and other bottles. Two years ago Mr. Cole invented a brush for cleaning decanters, and introduced it to the trade under the name of—"The Nonpareil Water Bottle and Decanter Brush." The brush answered well in most instances, but it was found too thick to pass the necks of many of the more modern decanters. It seemed at first that this defect could not be overcome without endangering the strength and efficiency of the brush, but Mr. Cole has now discovered that it can be accomplished with safety by the following method. His decanter brush, as originally made, was formed on a piece of beech wood, 12 inches long and $\frac{7}{10}$ square. For eight inches of the length the wood was turned round to serve as the handle, and to the remaining square piece of 4 inches he attached the brush. The holes for the bristles were bored down two sides of the square and at the end; and the other two sides were excavated to form a backway to the holes, through which to introduce the wire by which the bristles were to be drawn in. After the brush was made, the excavations were filled up with putty or cement. The width of these excavations was about $\frac{1}{8}$ of an inch, and if they could be dispensed with there would be $\frac{1}{8}$ of an inch in diameter gained, which is considerable in so small a space as the neck of a decanter. Now Mr. Cole dispenses with them in this way. Instead of making the brush on one piece of wood, the makes the sides of the brush in two parts, that is to say on separate pieces of wood, and then fits them together back to back, and pins them together with metal pins. Beech wood can be used as in the original brush, but he prefers for this new arrangement, hard wood or bone, as having more strength and closeness of grain. The slips of wood or bone may be a little longer than is necessary for the *brush part*, and when united by the pins the extra length may be turned, so as to fit in a stem of beech for a handle; or the slips may be of the full length requisite, that is about 12 inches, and united by pins the whole length, which last mode the patentee thinks both the best and cheapest. But as by this new arrangement there is no space for bristles at the end, to supply this deficiency he adopts one of three different contrivances. The first is to get a metal tube that will fit on to the top of the brush, and to insert a knot of bristles in the tube, and then to attach the tube to the brush. The second is to sew two pieces of plush together in such a manner, that they shall present two faces with the grain of each running in the same direction. This he inserts between the slips at the end of the brush, when pinning the two parts together, taking care to insert it so that the grain of the plush inclines towards the brush. The effect of this arrangement is, that in whatever way the brush is worked in the decanter, the plush presents its opposing grain to any surface it passes over, and consequently acts like a brush. The third method is to attach a flannel bag with a few shot enclosed, to the top of the brush. A flannel bag attached to a bent rod of wire is frequently used alone for cleaning decanters, but it has never been used in combination with brushes of the kind herein described.

The *seventh* and last improvement comprehended under the present patent relates to brushes for cleaning cruets and other small bottles, which the patentee makes in the following manner. He takes a slip of boxwood or bone, about 4 inches long, $\frac{1}{4}$ of an inch wide, and $\frac{1}{8}$ thick, and beginning at one end, he bores a row of holes about 2 inches long, boring the first hole in a sloping direction, so as to throw the bristles over the end of the wood, and gradually at each hole working to an upright. He then forms a groove at the back of the holes for the reception of the wire; the bristle is then drawn in, and cut off at any suitable height, and the wire covered over with cement, sealing-wax, or other suitable material, when the brush is complete.

Henry Jubber of Oxford, Confectioner, *for certain Improvements in Kitchen Ranges and Apparatus for Cooking*.—Enrolment Office, Dec. 2, 1841.

The peculiarity in this new kitchen range consists chiefly in two things,—first, in the spits being worked vertically, two on each side of a fire, and each spit carrying four joints, so that sixteen joints may be roasting at one and the same time; and, secondly, in shutting up the fire on all sides while the operation of "roasting" is going on, whereby "the entire heat" is said to be rendered "available." When it is desired to ascertain the progress of the roasting, or to baste the meat, or feed the fire, there are doors which may be readily opened for each purpose and then shut.

The inventor of these patent improvements in roasting, has evidently yet to learn what roasting is. He could not by the process he describes, with *closed doors*, roast at all, or produce any thing but *baked meats*. Neither is it likely to be generally regarded as an improvement, either in roasting or baking, to have four different joints dripping

one into the other, and intermingling their odours, so that when dished, the lamb shall have the flavour of beef, the mutton of pork, and *vice versa*; or, what is perhaps still more probable, a flavour so odiously compounded, as to smack "neither of flesh, fish, fowl, nor yet good red herring."

JAMES CHESTERMAN, OF SHEFFIELD, MERCHANT, AND JOHN BOTTOM, ALSO OF SHEFFIELD, MACHINIST, *for certain improvements in tapes for measuring, and in the boxes for containing the same.*—Rolls Chapel Office, January 11, 1842.

The *first* of these improvements (which are four in number) consists in partly or wholly forming the tape of metal. This may be done in various ways, but the patentees prefer introducing any convenient number of fine copper or silver wires in the warp of the tape, which are equally distributed throughout the width of the tape, one at or near each selvage, and the others at equal distances between them. "By these means, at a very trifling expense, the tape is made more durable, and prevented from stretching."

The *second* improvement relates to the boxes for containing the tapes, and consists in an improvement upon a former patent granted to J. Chesterman, (July 14, 1829.) Formerly, only one spring was used, and when required for long lengths, multiplying wheels and pinions were added; but, instead of the wheel-work, the patentee now employs an extra spring or springs, which are always constant and unvarying in their action, and not so liable to derangement.

The *third* improvement consists in applying the improved spring tape measure with a single or double spring, *or any other tape measure of whatever description*, to straight rules, sliding rules, *or any other rule or instrument requiring such an addition.* By way of example a drawing is given, which represents a method of applying a single spring tape measure to a 2 feet folding rule, so as to make it measure 6 feet when opened and the tape is drawn out—one spring being quite sufficient for this length.

The *fourth* and last improvement consists in the application of one, two, or more revolving plates of metal to the improved tape boxes, *or boxes of the ordinary construction.* These plates may be lettered and figured as may be required. In a drawing which illustrates this part of the specification, an almanac or indicator for ascertaining the day of the week upon which any day of the month will fall, is shown, as applied to a tape box; but it is frankly observed that any other table or tables, may be employed with equal advantage. Sometimes in the place of any table, almanac, or other printed information, the patentees substitute a plain sheet of paper, asses' skin, or other material; upon which, memoranda or calculations may be made and effaced.

The claim is to, "1st, the method of making tapes for measuring; consisting wholly of metal, or partly so, by the introduction of metal wires, open wire fabric, or plates of metal. 2. The construction of spring tapes, with two or more springs, for the purpose of obtaining sufficient power to wind up a long length of tape, instead of employing a single spring with wheel-work, as described in the specification of the said James Chesterman's former patent of July 14, 1829. 3rd. The adaptation or application of tape measures to straight rules, either jointed or otherwise, and also to other articles or instruments requiring such addition. 4th. The application of calculating tables, or plain sheets for calculating to tape boxes of any construction whatever, in the manner set forth and decribed."

The first claim is good; the second doubtful; the third and fourth preposterous.

ANTOINE JEAN FRANCOIS CLAUDET, OF HIGH HOLBORN, GLASS MERCHANT, *for certain improvements in the process or means of an apparatus for obtaining images or representations of nature or art.* Petty Bag Office, June 18, 1841.

The present improvements in Mr. Claudet's well-known process are five in number, and all apparently of importance.

The *first* consists in giving the front of the camera obscura, an aperture large enough to admit object glasses of various foci, so as to enable the operator to work either on large or small plates, and obtain images either of near or distant objects; and in affixing these various arrangements of glasses to sliding boards, which may be moved in front of the camera, or withdrawn, at pleasure.

The *second* consists in substituting for the detached mercury-box, ordinarily employed, a cup of mercury placed within the camera, and heated by a spirit lamp till the mercurial vapours rise and fill the camera. The light and mercury are made thus to act simultaneously on the plate, whereby a more intense and perfect image is obtained. In the side of the camera there is an eye-hole, covered with red or orange-coloured glass, through which the operator may watch the process, and be thus enabled to withdraw the plate the instant the proper effect is produced.

The *third* consists in placing immediately behind the sitter for a portrait, painted backgrounds or scenes, representing landscapes, interiors of apartments, &c., which, being thus brought within the range of the Daguerreotype apparatus, are transferred to the plate, as well as the likeness of the sitter.

The *fourth* consists in the employment, in

the absence of daylight, of an artificial light, produced either from the combustion of coal, promoted by a jet of oxygen gas, or from combustible gases and carburetted liquids burning together with oxygen; or from a solid refractory body suspended in a jet of inflammable gas, &c. Care must be taken that the burner is fixed exactly in the axis of the reflecting mirror, or that the greatest light falls on the centre of the curve.

The *fifth* and last improvement consists in performing the whole process in a lighted room, instead of in the dark, as has been hitherto the case. A white light must, however, be avoided, and screens of red, orange, green, or yellow, are therefore employed. Of these colours, red is preferred, as having the least injurious effect on the plates.

ADOLPHUS FOURMENT, OF MUSEUM-ST., ENGINEER, *for Improvements in Castors for Cabinet Furniture and other purposes.*—Enrolment Office, *June* 21.

These inprovements consist, "*First*, In a ball and socket forming the castor without anti-friction rollers of any kind, but with three points of contact cast or otherwise raised within the socket, which rest on the ball, and enable it to turn freely while supporting the superincumbent weight whatever it may be. *Secondly*, in case-hardening the said ball and socket either or both, as circumstances may require, where any extraordinary quantity of friction is anticipated."

No claim is made.

LIST OF DESIGNS REGISTERED BETWEEN JUNE 24TH, AND JULY 27TH, 1842.

| Date of Registration. | | Number in the Register. | Registered Proprietors' Names. | Subject of Design. | Time for which protection is granted. |
|---|---|---|---|---|---|
| June | 21 | 1323 | Edmund Heeley | Royal Sovereign Balance | 3 |
| | | 1324 | Robert Cogan | Lamp Chimney-glass | 1 |
| | 27 | 1325 | W. Fawcett and Co. | Carpet | 1 |
| | " | 1326 | T. Adams, Jordan, and Co. | Spring for Vehicles | 3 |
| | " | 1327 | Carron Company | Stove | 3 |
| | 28 | 1328,9 | H. Longden and Son | Ditto | 3 |
| | " | 1330 | James Shade | Easel for sketching or perspective drawing apparatus | 1 |
| | 29 | 1331 | B. Walton and Co. | Soda-water tap | 3 |
| | " | 1332 | Southbells and Co. | Carpet | 1 |
| | " | 1333,4 | H. and J. Dixon | Ditto | 1 |
| | " | 1335 | Jos. Warden, jun. | Axle-arm | 3 |
| | " | 1336 | J. Barber and Sons | Sketch on a hat-lining | 1 |
| | " | 1337 | William Thornthwaite | Dressing-case | 1 |
| July | 1 | 1338 | W. Fawcett and Co. | Carpet | 1 |
| | " | 1339 | Dobson and Co. | Ditto | 1 |
| | " | 1340 | John Barrett | Endless chain ink-distributor, for printing-machines | 3 |
| | " | 1341 | Watson and Sons | Carpet | 1 |
| | 4 | 1342 | Colin Macalpine | Machine for letter-press printing | 3 |
| | " | 1343 | Thomas Fyfe | Apparatus for attaching coulters to ploughs | 3 |
| | " | 1344 | John Skerman | Moulding-plough | 3 |
| | " | 1345,7 | Pardoe, Hoomans, and Co. | Carpet | 1 |
| | 6 | 1348 | H. Elliott Hoole | Fender | 3 |
| | 7 | 1349 | J. and E. Ratcliff | Slide-rack pulley | 3 |
| | 8 | 1350 | B. Walton and Co. | Coal-scoop | 3 |
| | " | 1351 | H. Smith | Horse-rake | 3 |
| | " | 1352,3 | H. and J. Dixon | Carpet | 1 |
| | " | 1354 | H. Knight | Case for a conical pendulum clock | 3 |
| | " | 1355 | Thomas Fyfe | Self-acting revolving horse-rake | 3 |
| | 11 | 1356 | John Entwistle | Cotton stuff | 1 |
| | " | 1357 | T. and H. Whitfield | Scales | 3 |
| | 12 | 1358,9 | Wright and Crump | Carpet | 1 |
| | 13 | 1360 | Thomas Heiffer | Raisor tang | 3 |
| | " | 1361 | Victoire Ferrari | Horizontal chirægemon, or pianoforte hand guide rod | 3 |
| | 14 | 1362 | J. Baker | Pencil-case | 3 |
| | 15 | 1363 | James Yates | Fender | 3 |
| | " | 1364 | George John Newbery | Poncho cloak | 3 |
| | 18 | 1365 | Alexander Shanks, jun. | Grass-cutting machine | 3 |
| | 19 | 1366 | Weiss and Son | Piston for surgical syringes | 3 |
| | " | 1367 | Samuel Mason | Peg-knife | 3 |
| | " | 1368 | Charles Beard | Invisible flower-trainer | 3 |
| | 20 | 1369 | Thomas Laming | Smoke-conductor | 3 |
| | " | 1370 | Henry Brunton | Carpet | 1 |
| | 21 | 1371 | Henry Duke, sen. | Metallic comb | 3 |
| | 22 | 1372 | William Smith | Scotch needle-case | 1 |
| | " | 1373 | David Craven | Chimney-sweeping machine | 3 |
| | " | 1374 | J. Simonds and C. Day | Spring hook | 3 |
| | 25 | 1375 | H. and J. Dixon | Carpet | 1 |
| | " | 1376 | Philip J. Luntley | Lamp-glass | 1 |
| | 26 | 1377 | Holden, Lowe, and Lowe | Hinge | 3 |
| | " | 1378 | Joseph Guise | Lamp | 3 |
| | " | 1379 | William Mitchell | Ink reservoir pen | 3 |
| | 27 | 1380 | George John Newbery | Cloak | 3 |

LIST OF ENGLISH PATENTS GRANTED BETWEEN THE 6TH AND THE 28TH OF JULY, 1842.

John Harrison Scott, of Somers Town, engineer, for certain improvements in metal pipes, and in the manufacture thereof. July 6; six months.

George Edmund Donisthorpe, of Bradford, top manufacturer, for improvements in combing and drawing wool, and certain descriptions of hair. July 6; six months.

Joseph Hall, of Cambridge, agricultural implement maker, for certain improvements in machinery for tilling land. July 6; six months.

Lady Ann Vavasour, of Melbourne Hall, York, for improvements in obtaining images on metallic and other surfaces. July 7; six months.

Richard Hodgson, of Montague-place, gentleman, for improvements in obtaining images on metallic and other surfaces. July 7; six months.

James Timmins Chance, of Birmingham, glass manufacturer, for improvements in the manufacture of glass. July 7; six months.

Charles Augustus Prellet, of East Cheap, merchant, for improvements in machinery for preparing, combing, and drawing wool and goat's hair. (Being a communication.) July 7; six months.

William Fairbairn, of Manchester, engineer, for certain improvements in the construction of metal ships, boats, and other vessels, and in the preparation of metal plates to be used therein. July 7; six months.

John Perring of Cecil House, Strand, hat manufacturer, for improvements in wood paving. July 7; six months.

John Bird, of Manchester, machinist, for certain improvements in machinery, or apparatus for raising or forcing water, and other fluids; which said improvements are also applicable as an engine, to be worked by steam for propelling vessels, and other purposes. July 7; six months.

William Richard the Elder, of Burley Mills, Leeds, manufacturer, for an improved method of consuming or preventing smoke, and economising fuel in steam engines, and other furnaces. July 7; two months.

William Revell Vigers, of Russell-square, Esq., for a mode of keeping the air in confined places in a pure or respirable state, to enable persons to remain or work under water, and other places, without a constant supply of fresh atmospheric air. (A communication.) July 7; six months.

John Peter Booth, of the city of Cork, merchant, for certain improvements in machinery and apparatus for working in mines, which are applicable to raising, lowering, and transporting of heavy bodies; and also affording assistance in promoting a more perfect ventilation of the mine. July 9; six months.

Jean Baptiste Francois Jouannin, of Upper Ebury-street, Pimlico, mechanic, for certain improvements in apparatus for regulating the speed of steam-air, or water-engines. (Being a communication.) July 9; six months.

James Crutchett, of William-street, Regent's-park, engineer, for improvements in manufacturing gas, and an apparatus for consuming gas. July 12; six months.

Thomas Deakin, of Sheffield, merchant, for improvements in the manufacture of parts of harness and saddlery furniture. July 12; six months.

Jean Leandre Clement, of St. Martin's-lane, engineer, for improvements in apparatus for ascertaining the temperature of fluids and also the pressure of steam. July 12; six months.

William Henry Stuckey, of St. Petersburgh, now of Upper North-place, esq., for a pneumatic engine for producing motive power. July 12; six months.

Joseph Schlesinger, of Birmingham, manufacturer, for certain improvements in inkstands and in instruments for filing or holding papers and other articles. July 16; six months.

Robert Benton, of Birmingham, land-agent, for certain improvements in propelling, retarding and stopping carriages on railroads. July 16; six mo.

Joseph Barling, of High street, Maidstone, watchmaker, for certain improvements in producing rotary motion in machinery worked by manual labour. July 16; six months.

John Chativin, of Birmingham, button manufacturer, for improvements in the manufacture of covered buttons. July 16; six months.

Charles Robert Ayers, of John-street, Berkeley-square, architect, for improvements in ornamenting and colouring glass, earthenware, porcelain and metals. July 23; six months.

Joseph Partridge, of Bowbridge, near Stroud, Gloucester, dyer, for certain improvements in cleansing wool. July 23; six months.

Eugene de Varroc, of Bryanstone-street, Portman-square, for apparatus to be applied to chimneys, to prevent their taking fire, and for rendering sweeping of chimneys unnecessary. July 23; six months.

Alexander Johnstone, of Hill House, Edinburgh, esq., for certain improvements in carriages, which may also be applied to ships, boats, and other purposes where locomotion is required. July 25; six months.

Edward Cobbold, of Melford, Suffolk, master of arts, clerk, for certain improvements in the means of supporting, sustaining and propelling, human and other bodies on and in the water. July 28; six months.

*The Late Solar Eclipse.*—We have been indulged with the perusal of a private letter from that excellent astronomer F. Baily, Esq., giving an account of this superb phenomenon, as witnessed by himself at Pavia, over which town the line of central darkness exactly passed. The appearances were every way extraordinary, unexpected, and most singular. At the moment when the total obscuration commenced, a brilliant crown of glory encircled the moon, like the "Aureola," which Catholic painters append to their saints. *Suddenly, from the border of the black and labouring moon, thus singularly enshrined, burst forth at three distinct points, within the aureola, purple or lilac flames!* visible to every eye. At this moment, from the whole assembled population of the town, a simultaneous and deafening shout broke forth. A similar manifestation of popular feeling is recorded at Milan, occasioned by the selfsame astonishing spectacle, accompanied in the latter instance with a general "*Huzzah! vivent les astronomes!*" The eclipse was also viewed from the Superga, near Turin, by our Astronomer Royal, Mr. Airy, apparently under less favourable circumstances. We have yet heard of no astronomer witnessing from a great elevation in the Alps the shadow striding from peak to peak, or blotting in succession the fair fields of North Italy. Such an exhibition must have been perhaps the sublimest which the eye of man can ever witness as a mere physical phenomenon.—*The Athenæum.*



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# Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 991.] SATURDAY, AUGUST 6, 1842. [Price 3*d*.

Edited, Printed and Published by J. C. Robertson, No. 166, Fleet-street.


## CHATTERTON'S IMPROVED PADDLE-WHEELS.

Fig. 1.

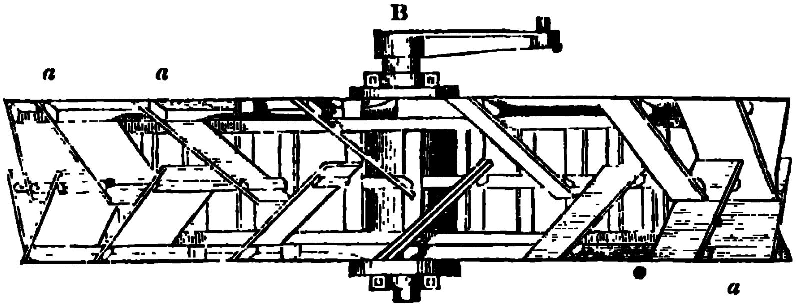



Fig. 2.

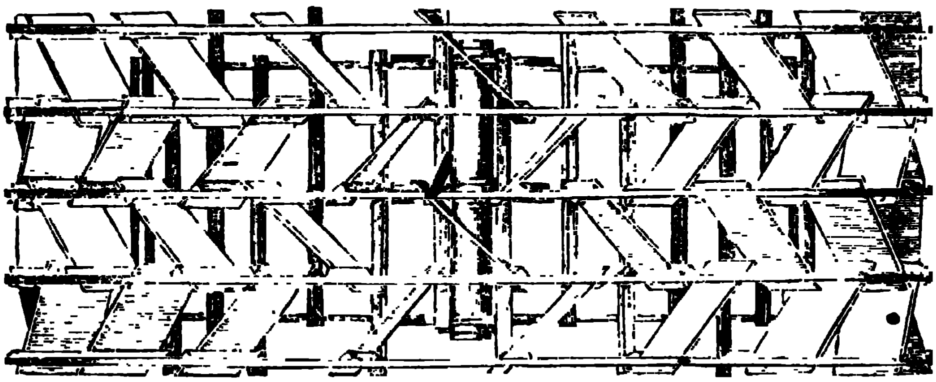
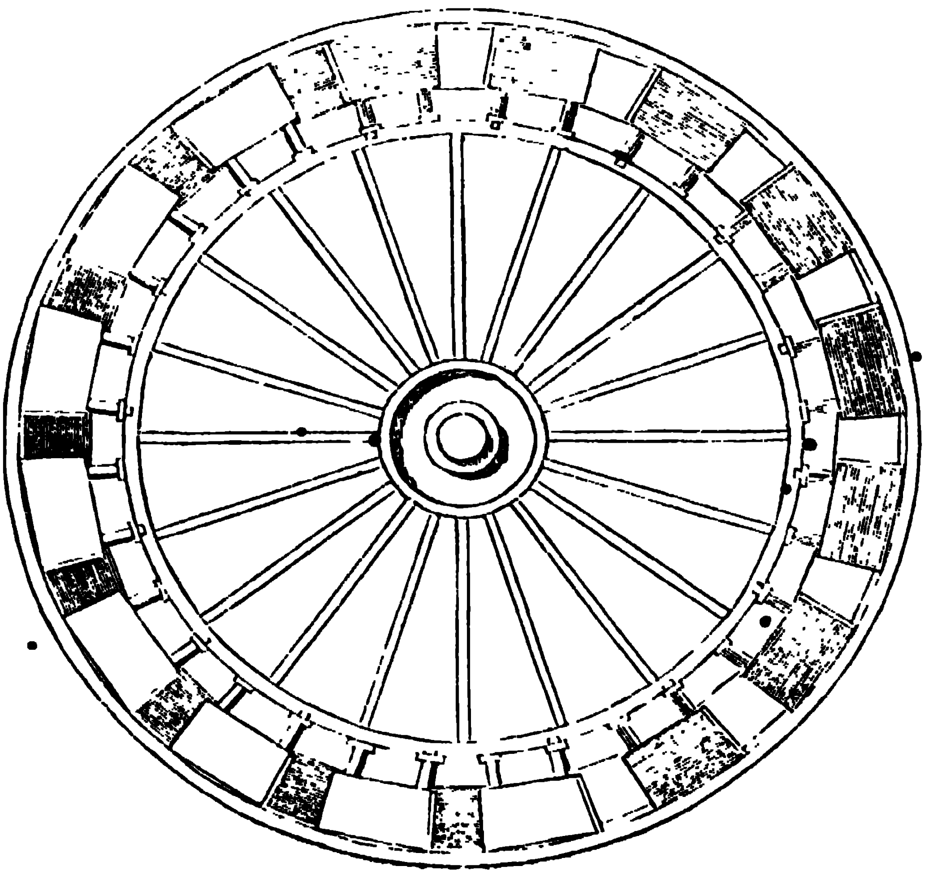


Fig. 3.



## CHATTERTON'S IMPROVEMENTS IN PROPELLING.

[Patent dated 11th January, 1842.]

The present improvements in propelling consist of a new arrangement of the floats of the ordinary paddle-wheel, which is very distinctly represented in the accompanying engravings, and is thus described by the inventor, in his specification:—

"Figs. 1 and 2 represent a paddle-wheel of a steam-vessel, constructed in the ordinary manner, except only as regards the floats, *a a a a*: instead of these floats being placed parallel to the shaft or axis B, as such floats are now usually placed, they are fixed obliquely, at a considerable angle thereto, and in alternate opposition to one another, as shown in the drawing, each float projecting beyond that opposite to it. By placing the floats in these relative positions, the amount of direct resistance from the water, and of propulsive power thereby obtained, is greater than is obtainable within the same width of space, by any other arrangement of floats with which I am acquainted, while at the same time the power is exerted unintermittingly and continuously throughout each entire revolution of the wheel, and acts in an equable and steady manner on the vessel and its machinery. In consequence, too, of the oblique direction in which the floats enter into and emerge from the water, as well as of the water being drawn, as it were, into the interior of the wheel, between the floats, there is less of that back lift and dashing of the water against the sides of the vessel, which are so much complained of, and are so peculiarly objectionable in canal and river navigation."

Instead of one set of floats, placed in alternate opposition to one another, as represented in figs. 1 and 3, the patentee states that two or more sets may be placed side by side, in the manner shown in fig. 2.

We see no reason to question that a paddle-wheel, with floats set in the manner invented by the patentee, will be greatly superior to the common wheel. All the schemes which have been hitherto proposed for the improvement of the common wheel, appear to have only served to produce a wider-spread conviction than ever among practical men, that no wheels are so well adapted to the rough work to which steam-vessels are exposed—ocean steamers especially—as those which have fixed and well-secured floats. Mr. Chatterton does not quarrel with this conviction; but contends, only, that fixed floats may be *fixed* at such angles with respect to the plane of motion and to one another, as to realize nearly all the advantages predicated of the various feathering paddle-wheels which have at different times been brought before the public. He states what he thinks are the best angles for the purpose, ("but without confining himself to these precise angles,") and gives reasons for preferring them, the soundness of which will, we think, be very generally admitted. We beg, however, not to be understood as looking on the feathering system as one to be abandoned in utter despair—thinking, on the contrary, well of it, and hoping still to see it produce good fruit. All we mean to say is, that, so far as the most approved practice of the present day goes, the paddle-wheel of Mr. Chatterton is a step in advance, and one which, though in an *oblique*, is nevertheless quite in the *right* direction.

The plan of Mr. Chatterton has, we understand, been already adopted with acknowledged advantage in Canada, (the birth-place of the invention;) and it is now in course of application to one of the vessels of the St. George's Steam-packet Company, which will soon afford the British public an opportunity of judging of its merits, from ocular demonstration.

## THE CASE IN LIFE ASSURANCE MR. SCOTT IN CONTINUATION.

Sir,—Having in my last communication promised to give another solution of Iver M'Iver's Question on Life Annuities deduced from more healthy tables than those of Northampton, I have made out the following calculations from the duration of life given by *Mr. Muret* in the first part of the *Berne Memoirs*. It will be found that the Swiss Table of Mortality agrees very nearly with the *Carlisle* Table of the Duration of Life; the mortality between the ages of 23 and 43 by the Swiss Table being expressed by the decimal ·1828, and the Carlisle by ·1833. The number living by the Swiss Table, at the age of 23 is 597; at 24, 592, &c., and at 43, 488;

hence, $488 \times 100 = £48,800$ would be the probable sum to be divided among the survivors at the end of 20 years (in the first Solution the number living at the age of 23 was supposed to be 100, but there is no necessity for this restriction,) and supposing the rate of interest 3 per cent. then P will be found in the same way as in the last solution to be 8·47686 and $597 \times P \times R^{20} \times x = 48800$. And,

$$x = \frac{48800}{597 \times 8{\cdot}47686 \times 1{\cdot}806111}$$

$= £5.340 = £5.\ 6.\ 9\tfrac{1}{2}$ annual premium.

The calculation for finding the annual premium may be otherwise performed as follows:

Suppose the number of subscribers to be equal to the number living at the given age in the Table, and that each subscribes £1 annually, and let the interest be 3 per cent.

| Age. | Living. | Amount of £1 | Amount of Improved Prems. | |
|---|---|---|---|---|
| 23 | 597 × | 1.806111 | 1078·218 | 1st premium improved for 20 years. |
| 24 | 592 | 1·753566 | 1038·076 | 2nd ................ 19 .. |
| 25 | 587 | 1·702433 | 999·328 | 3rd ................ 18 .. |
| 26 | 582 | 1·652857 | 961·951 | 4th ................ 17 .. |
| 27 | 577 | 1·604706 | 925·915 | 5th ................ 16 .. |
| 28 | 572 | 1·557967 | 891·157 | 6th ................ 15 .. |
| 29 | 567 | 1·512589 | 857·638 | 7th ................ 14 .. |
| 30 | 565 | 1·468533 | 826·781 | 8th ................ 13 .. |
| 31 | 558 | 1·425760 | 795·571 | 9th ................ 12 .. |
| 32 | 553 | 1·384233 | 765·481 | 10th ................ 11 .. |
| | Total sum arising from £1 Annual Prem. | | 9140·152 | |

Hence, $48800 \div 9140{\cdot}152 = £5.339 = £5.\ 6s.\ 9\tfrac{1}{4}d.$ annual premium. And by either of the methods when the rate of interest is 4 per cent., the annual premium will be found to be £4. 11*s*. 7*d*., and $P = 7{\cdot}89710$. Let us now suppose that the whole were to be paid by a single premium, and the interest to be 3 per cent: According to the Northampton Table, if $s$ = single premium, $n$ = number of subscribers; then $R^{20} \times s\,n$ = probable amount of all the premiums at the end of 20 years. Hence, $s\,n\,R^{20} = 6933$

$$s = \frac{6933}{n R^{20}} = \frac{69}{R^{20}} = \frac{69}{1{\cdot}806111} =$$

$£38{\cdot}386 = £38.\ 7s.\ 8\tfrac{1}{2}d.$ Similarly when the rate is 4 per cent. $s = 69 \div 2{\cdot}191123 = £31.\ 12s.\ 9\tfrac{3}{4}d.$ But by the Swiss Table

$$s = \frac{48800}{R^{20}\,n} = \frac{48800}{1{\cdot}806111 \times 597}$$

$= £48{\cdot}6:3 = £48.\ 12s.\ 5\tfrac{1}{2}d.$; and when the rate is 4 per cent., then

$$s = \frac{48800}{2{\cdot}191123 \times 597} = £40{\cdot}0906$$

$= £40.\ 1s\ 9\tfrac{3}{4}d.$

The remaining calculations I will finish in my next communication.

I am, &c.

GEORGE SCOTT.

Cochrane Terrace, August 1, 1842.

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## ON TESTING THE EFFICIENCY OF FURNACES, AND ON MR. HOLDSWORTH'S PYROMETER. BY C. W. WILLIAMS, ESQ.

(Continued from page 60.)

SIR,—Since my last communication, I have given much attention to the application of Mr. Houldsworth's pyrometer, and the advantages to be derived from its use when applied as a means of testing the relative values of different descriptions of coal, or of the several modes of effecting their combustion in furnaces. Mr. Houldsworth stated at the meeting of the British Association in Manchester, that, in testing the operations of the furnace, he was not satisfied with the results obtained from the use of the thermometer bar, inserted in the flues (as already described by me in the Mechanics' Magazine): and hence, that he was induced to make those experiments with the wire pyrometer, the results of which were exhibited in the diagram, as inserted in the Magazine, No. 988, p. 58.

Although fully convinced of the value of this wire pyrometer and its superiority

over the thermometer conductor bar, I am not prepared entirely to dispense with the latter. Inferior, certainly, as it is to Mr. Houldsworth's pyrometer in the rapidity and correctness with which it indicates the fluctuations of temperature in the flues of a boiler, it has nevertheless great advantages as a permanent indicator of the maximum and minimum ranges of such temperature; from which the engineer soon learns to form a series of valuable inferences as regards the state of the flues,—the general action of the furnace,—and, above all, the heat-generating faculty of any kind of coal, or mode of effecting its combustion.

Independently, however, of the practical value of Mr. Houldsworth's wire pyrometer, I hail its introduction as of the last importance at this particular period, when the subject of the "smoke nuisance" has engaged so much attention, and when so many are desirous of being set right, not only as to the means of abating that nuisance, but as to testing the relative value or applicability of the several kinds of furnaces which are daily presented to their notice. On turning my attention to this subject some few years back, as a matter of business, and desirous of comparing the several "smoke-burning" and fuel economizing plans, no other test presented itself or was even thought of, but that of evaporation. I was perplexed, however, by the prevailing uncertainty and total absence of principle or system, even among our most eminent Mechanical Engineers. No scientific or satisfactory reason was given for preferring one description of furnace or boiler to another: and as to practical results, matters were still more inconclusive. The application of one kind of furnace, which was found to succeed with one class of boilers, was wholly unsuccessful when applied to another class. Each Engineer had his own, *pro tempore* mode of calculation and construction, as regards boilers: yet these were ever changing, and still are as far as ever from either certainty or perfection.

When, again, I looked to writers on the subject, I found still less reason to be satisfied. With them, all that regarded either the furnace or the boiler, and all the details of ash-pit, fire-bars, flues, and even areas for the admission, escape, or draught of air, were at once reduced to a question of proportions—mere mechanical proportions, unaccompanied by any chemical or scientific reason. With all these endless varieties of furnaces and boilers and proportions, the sole comparative test of efficiency was evaporation—the weight of water evaporated by a given weight of fuel. That this was not only a fallacious but deceptive and dangerous test, was manifest from the fact, that the same description of furnace and fuel was attended by a large measure of evaporation when applied to one plan of boiler, and the reverse when applied to another. It was clear that there was something radically wrong in our mode of proceeding. Two things were manifest, *first*, that the relative value of the processes of combustion as they occur in different kinds of furnaces, with their purely chemical combinations and effects, must be tested by some other means than by mere reference to the secondary process of evaporation in boilers: and, *secondly*, that a knowledge of the principles on which furnaces and boilers should be constructed, with reference to their respective but very different functions, must be sought for in some more rational and scientific course of proceeding, than by a mere calculation of sizes and surfaces, mechanically considered. In a word, that the branch of science which treats of the generation of heat, by combustion, from fuel, must be separated in our experiments, as well as in our minds, from that of the generation of steam by evaporation from water—two objects which have nevertheless hitherto been so unaccountably and unscientifically compounded, and have so long prevented our obtaining correct or systematic results as to either.

In illustration of the vagueness which attends all experiments where this confusion prevails, I have arranged in the form of Tables, the results of nine experiments made under my own eye, together with others which have been most relied on by Mr. Parkes and Mr. Wicksteed. These Tables I submitted to the mechanical section of the British Association at Manchester, in consequence of the interest taken in that town on the "smoke nuisance" prevention. I now submit them to your readers with the same object,—the showing how liable we are to be deceived by results and inferences drawn from these two popular modes of proceeding, namely, the constructing boilers

and furnaces by empirical rules drawn from a calculation of mere mechanical sizes and surfaces: and the testing the heat-generative properties of a furnace by the evaporative powers of a boiler.

On both these points these Tables are decisive, in proving the utter fallacy of the inferences hitherto drawn, and the absence of all system, or the means of correct calculations as regards either the size of the furnace, the surfaces of the boiler, the fuel used, or the water evaporated.

Among those practical men who had hitherto looked to the measure of evaporation as the test of relative merit in the various "smoke-burning" systems, none has given more attention to the subject than Mr. Houldsworth. In search of truth and practical effect, on the large scale, he has pursued the inquiry for years, and to him we are now indebted for the means of testing the heat-generative values of the various modes of producing combustion in furnaces, by direct reference to the actual amount of heat generated, rather than by the indirect process of evaporation, which can only indicate what portion of the heat has been *applied*. To the use of Mr. Houldsworth's wire pyrometer I will again revert, being engaged in a course of experiments on the subject. The Tables now submitted sufficiently demonstrate the little dependence that can be placed on evaporation as the means of ascertaining the value of any kind of furnace. They also show that, in the construction of either furnace or boiler, this eternal and exclusive reference to mere mechanical properties, sizes, and areas, is as unsound and inconclusive as it is unscientific. This latter subject I propose continuing in my next communication.

I am, Sir, yours, &c.,
C. W. WILLIAMS.

Liverpool, July 15, 1842.

*Conclusions deduced from the accompanying Tables.*

1. That the quantity of water evaporated by any *given weight* of fuel, (as shown in column 10,) furnishes no test of the quantity evaporated in any *given time*, (as shown in column 9.)

2. That the quantity of water evaporated by each pound of coal is a very inadequate test of the quantity of heat given out by such coal, or the perfection of the process of combustion carried on in the furnace and flues; inasmuch as the steam generated is only in proportion *to the heat taken up* by the water, and not to the *heat generated* from the coal.

3. That, as the weight of water evaporated *per pound of coal* bears no proportion to the weight of water evaporated *per hour*, economy of *fuel* may, (according to the demands of the engine,) be the reverse of economy of *time;* and, as the work done may be estimated in proportion to the weight of water evaporated *per hour*, rather than the *weight* of fuel used, the latter can be no test of the former.

4. That the size or area of the furnace, or heating surface of the boiler, (as shown in columns 5 and 6,) has no necessary connexion with the heat-generating power of the coal, as shown in columns 9 and 11; (See Experiments Nos. 8 and 11, and Nos. 7 and 13.)—the latter depending on the management and construction of the furnace—the quantity and mode of admitting air, and the rate of combustion, and not on any scale of proportions.

5. That the power of any description of *coal* should be tested by the quantity of *heat* produced:—the efficacy of any description of *furnace*, by the degree of perfection in which the process of combustion is carried on:—and the value of any kind of *boiler*, by the quantity of water evaporated. In experimenting with the first, (the coal,) we must be guided by the thermometer, or pyrometer; with the second, (the furnace,) by the eye, in observing the colour and character of the flame in the flue, and the absence from smoke; and with the third, (the boiler,) by the quantity of steam supplied to the engine in any given time. Each, however, should be tested by itself.

6. That, in estimating the effect produced by any kind of coal or description of furnace, (if a boiler be used,) we must take into account, not only the weight of water evaporated, but also the temperature of the escaping products, (as shown in column 11), the heat passing by the chimney being as well entitled to be considered as *work done* by the coal, as that which passes into the boiler doing the work of evaporation.

7. That the temperature of the products escaping by the chimney will be in the ratio of the heat in the flues, and both, in the ratio of the rate of combustion and the quantity of heat generated.

## TABLE 1.

*(Experiments arranged in the Order of Economy of Fuel used, as shown in Column 10.)*

Showing that the Weight of Water Evaporated by each Pound Weight of Coal bears no Relation to that Evaporated per Hour; and, therefore, that what is called Economy of *Fuel* may be a ruinous waste in *Time* and *Work* done by the Engine.

| No. | Column 1. Regulation as to Air admitted to Gases. | Column 2. Kind of Coal used. | Column 3. Mode of Firing, and Rate of Combustion. | Column 4. Size of Furnace. | Col. 5. Area of Furnace | Col. 6. Area of Flue Surface. | Col. 7. Time. | Col. 8. Weight of Coal used. | Col. 9. Water evaporated. | Col. 10. Water evaporated per lb. of Coal. | Col. 11. Temperature of escaping products. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Sq. feet. | Sq. feet. | Hour. | lbs | lbs. | lbs. | Degrees. |
| 1 | Air excluded, much smoke .. | St. Helens .... | Active Combustion...... | Full size .... | 7·8 | 300 | 1 | 158 | 653 | 4·12 | 515 |
| 2 | Air admitted behind the bridge, No. S. | | | | | | | | | | |
| 3 | ,, no smoke........ | ,, .... | Slow ditto ............ | Ditto ...... | 7·8 | 300 | 1 | 89 | 650 | 7·30 | 730 |
| 4 | ,, ditto ........... | ,, .... | Active ditto............ | Reduced size.. | 6·25 | 300 | 1 | 158 | 1136 | 7·18 | 1005 |
| 5 | ,, ditto ........... | Risca Rock .... | Active ditto............ | Full size .... | 7·8 | 300 | 1 | 160 | 1214 | 7·57 | 1050 |
| 6 | ,, ditto ........... | St. Helens .... | Active ditto............ | Ditto ...... | 7·8 | 300 | 1 | 224 | 1715 | 7·68 | 1193 |
| 7 | ,, ditto ........... | Unscreened Wesh.. | Active ditto............ | Ditto ...... | 7·8 | 300 | 1 | 130 | 1061 | 8·15 | 982 |
| 8 | ,, ditto ........... | Screened Welsh .. | Active ditto............ | Ditto ...... | 7·8 | 300 | 1 | 160 | 1360 | 8·50 | 1150 |
| 9 | ,, ditto ........... | St. Helens .... | Slow ditto ............ | Ditto ...... | 7·8 | 300 | 1 | 149 | 1288 | 8·63 | 1087 |
| | ,, ditto ........... | ,, .... | Slow ditto ............ | Reduced size.. | 6·25 | 300 | 1 | 112 | 1030 | 9·30 | 975 |
| 10 | From Parkes's Printed Table.. | ........ | ........................ | Small Furnace | 17·6 | 320 | 1 | 203 | 1160 | 5·71 | |
| 11 | ,, .... | ........ | ........................ | Large Furnace | 20·3 | 320 | 1 | 162 | 1351 | 8·32 | |
| 12 | From Wicksteed's Printed Table | ........ | One Boiler—Wagon .... | ............ | 12.5 | 196 | 1 | 165 | 1289 | 7·80 | |
| 13 | ,, ,, .... | ........ | Two Boilers—Cornish plan | ............ | 39·5 | 1596 | 1 | 163 | 1403 | 8·58 | |
| 14 | Parkes's, with Perkins's Boiler | Coke ........ | ........................ | ............ | 20·0 | 226 | 1 | 154 | 1448 | 9·37 | |
| 15 | Ditto ditto .... | Ditto ........ | ........................ | ............ | 20·0 | 226 | 1 | 123 | 1280 | 10·42 | |
| 16 | Ditto ditto .... | Ditto ........ | ........................ | ............ | 20·0 | 226 | 1 | 105 | 1154 | 10 82 | |
| 17 | Ditto ditto .... | Ditto ........ | ........................ | ............ | 20·0 | 226 | 1 | 90 | 990 | 11·00 | |

TABLE 2.

(*The above Nine first Experiments arranged in the Order of Economy of* Work *done in a given time, as shown in Columns* 9 *and* 11.)

| No. | COLUMN 1. Regulation as to Air admitted to Gases. | COLUMN 2. Kind of Coal used. | COLUMN 3. Mode of Firing, and rate of Combustion | COLUMN 4. Size of Furnace. | COL. 5. Area of Furnace | COL. 6. Area of Flue Surface. | COL. 7. Time. | COL. 8. Weight of Coal used. | COL. 9. Water Evaporated. | COL. 10 Water Evaporated, per lb. of coal | COL. 11. Temperature of escaping products |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Sq. feet. | Sq. feet. | Hour. | lbs. | lbs. | lbs. | Degrees |
| 1 | Air excluded, much smoke | St. Helens ...... | Active ...................... | Full size .... | 7·8 | 300 | 1 | 158 | 653 | 4·12 | 515 |
| 2 | Air admitted, no smoke.. | ,, ...... | Slow combustion, ash-pit closed.. | Ditto ...... | 7·8 | 300 | 1 | 89 | 650 | 7·30 | 730 |
| 9 | ,, ,, | ,, ...... | Slow Combustion ........... | Reduced size.. | 6·26 | 300 | 1 | 112 | 1030 | 9·30 | 975 |
| 6 | ,, ,, | Unscreened Welsh | Active ...................... | Full size .... | 7·8 | 300 | 1 | 130 | 1061 | 8·15 | 982 |
| 3 | ,, ,, | St. Helens ...... | Active ...................... | Reduced size.. | 6·26 | 300 | 1 | 158 | 1136 | 7·18 | 1005 |
| 4 | ,, ,, | Risca Rock ...... | Active ...................... | Full size .... | 7·8 | 300 | 1 | 160 | 1214 | 7·57 | 1050 |
| 8 | ,, ,, | St. Helens ...... | Slow Combustion ........... | Full size .... | 7·8 | 300 | 1 | 149 | 1288 | 8·63 | 1067 |
| 7 | ,, ,, | Screened Welsh .. | Active ...................... | Full size .... | 7·8 | 300 | 1 | 160 | 1360 | 8·50 | 1150 |
| 5 | ,, ,, | St. Helens ...... | Active ...................... | Full size .... | 7·8 | 300 | 1 | 224 | 1715 | 7·68 | 1193 |

Thus we find that the temperature (indicated by column 11) of the escaping products increases as the quantity of water evaporated (indicated by column 9, table 2) also increases.

8. That, with *slow combustion*, (effected by limiting the admission of air to the ash-pit, rather than the use of the damper in the chimney,) economy of *fuel* will be *increased*, because more of the heat generated will then be absorbed by the water. Economy of *time*, however, will, in such case, be *sacrificed*, because less heat will be generated per hour.

9. That, on the contrary, with *rapid combustion*, if it be perfect, economy of *time* will be *increased*, because more heat will then be generated *per hour*, and, consequently, more water evaporated. Economy of *fuel*, however, will, in this latter case, be *sacrificed*, because greater waste will be occasioned by the increased temperature of the escaping products.

10. That this further proves, that *evaporative economy* is twofold, namely, as regards *time* and *fuel*. Economy of *time*, as represented by the amount of work done, or steam generated per hour, (as shown in column 9;) and economy of *fuel*, as represented by the weight of coal used per pound of water evaporated, (as shown in column 10).

The above results lead to the following general results: that, in testing the efficiency of any plan of *furnace*, or mode of admitting air, or quality of any kind of coal, we must be guided by the relative quantities of heat generated; whereas, in testing the efficiency of any description of *boiler*, we must be guided by the quantity of heat it can take up, as evidenced by the weight of water evaporated. In all, however, *the quantity of heat escaping by the chimney shaft must be taken into account*.

In any inquiry, therefore, after practical results, it is essential to provide, first, the means of internal inspection, by which the colour and character of the flame in the flues may be observed, with the absence of smoke; and, secondly, of ascertaining the temperature of the products of combustion, as well in the flues as those escaping by the chimney. The former may be obtained by sight-holes, properly placed; the latter, by the aid of thermometers and pyrometers. The most effectual and practically useful pyrometer yet applied is that

of the expansion wires or rods, adapted after the manner suggested by Henry Houldsworth, Esq., and explained by him at the late meeting of the British Association, in Manchester, where he exhibited a diagram of the results obtained. — *(See Mechanics' Magazine, No. 988, page 58.)*

## PLAN FOR THE VENTILATION OF SHIPS OF WAR, PUBLIC BUILDINGS, ETC

Fig. 1.

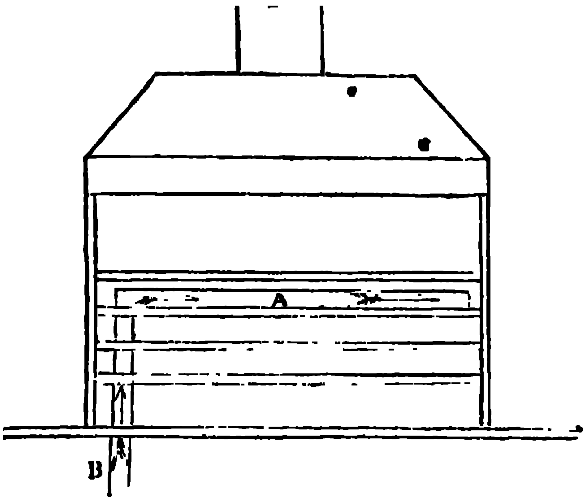



Fig. 2.

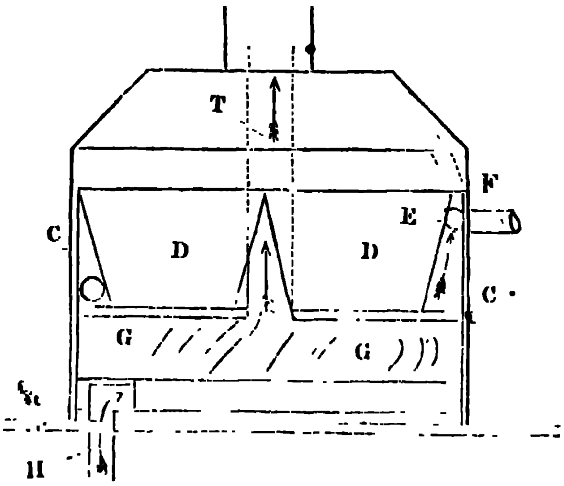
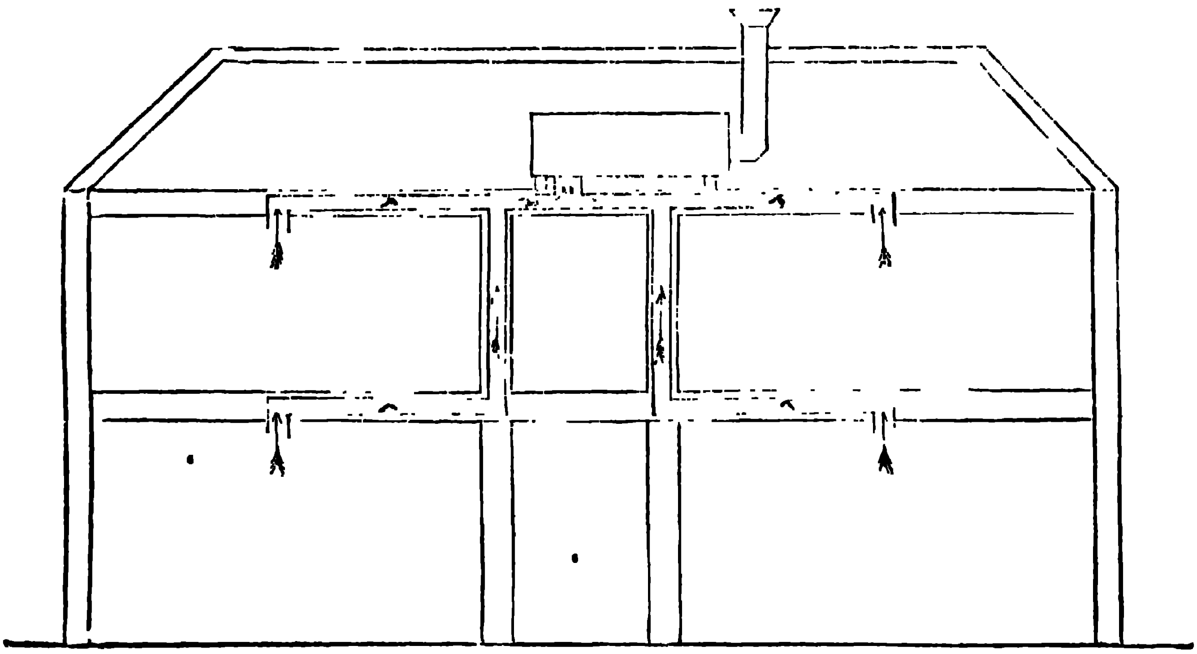



Fig. 4.



Sir,—I beg leave to forward you a very simple, effective, and to me, novel plan for ventilating and warming ships of war, transports, hospitals, &c., and as it is an important object, I trust you will deem it worthy of publication.

Figs. 1 and 2 represent a front and back view of the fire-place which I have designed for ships; it consists of an open grate in front with coppers, or boilers behind, which are heated by means of a stove.

Through the open fire-place, fig. 1, there passes an iron pipe A A, connected at one end with B, whose ramifications, as seen in fig. 3, lead to various parts of a ship, the other end passing into the air-chamber C, fig. 2, in which the coppers,

or boilers, D D, are suspended. At E there is a valve opening into the chimney

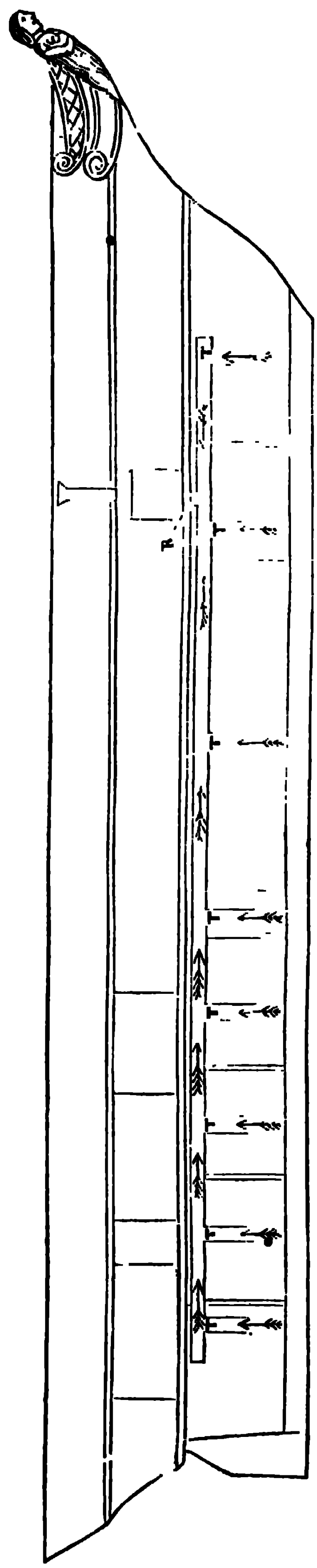


Fig. 3.

as shown by the dotted lines, and also a pipe F, connected with tubing supposed to be conducted round the decks of a ship.

When the fire is lighted, the air in the tubes A A, being rarefied, passes into the air-chamber C, and thence, when the valve is open, into the chimney, consequently causing a current of air to flow from any part of a ship at pleasure, as the branch piping seen in fig. 3, is supplied with taps. By closing this valve, the hot air may be permitted to flow through the pipe F and its tubing, thus warming the upper deck—a great comfort in cold latitudes, especially on board troop ships.

The posterior part of the fire place consists of coppers or boilers D D, suspended in the air chamber C, and heated by means of the stove G, which is also rendered contributory to ventilation, as the only channel for supplying it with air for combustion is through the pipe H, which is also connected with those leading to various parts of the hold, as shown in fig. 3. The dotted lines T, represent the course of the chimney leading from the stove.

As a matter of course, when the boilers are in use, the valve E is closed.

The same system of ventilation may be applied to a public building, as shown in the sectional view, fig. 4. The stove is placed in the attic, which, when the fire is lighted can only be supplied with air from some one of the four chambers, and as the piping leading from them has valves, it is evident that any of them may be ventilated at pleasure. This stove may be used as a cooking apparatus, or should it be intended to warm the various rooms, it may be fitted with a boiler having piping to conduct hot-water in any desired direction.

I am, your very obedient servant,

EDMUND BUTLER ROWLEY.

Manchester, 11, Upper Brook-street,
July 2, 1842.

## PURE WATER FOR LONDON—MR. STUCKEY'S PLAN OF FILTRATION.

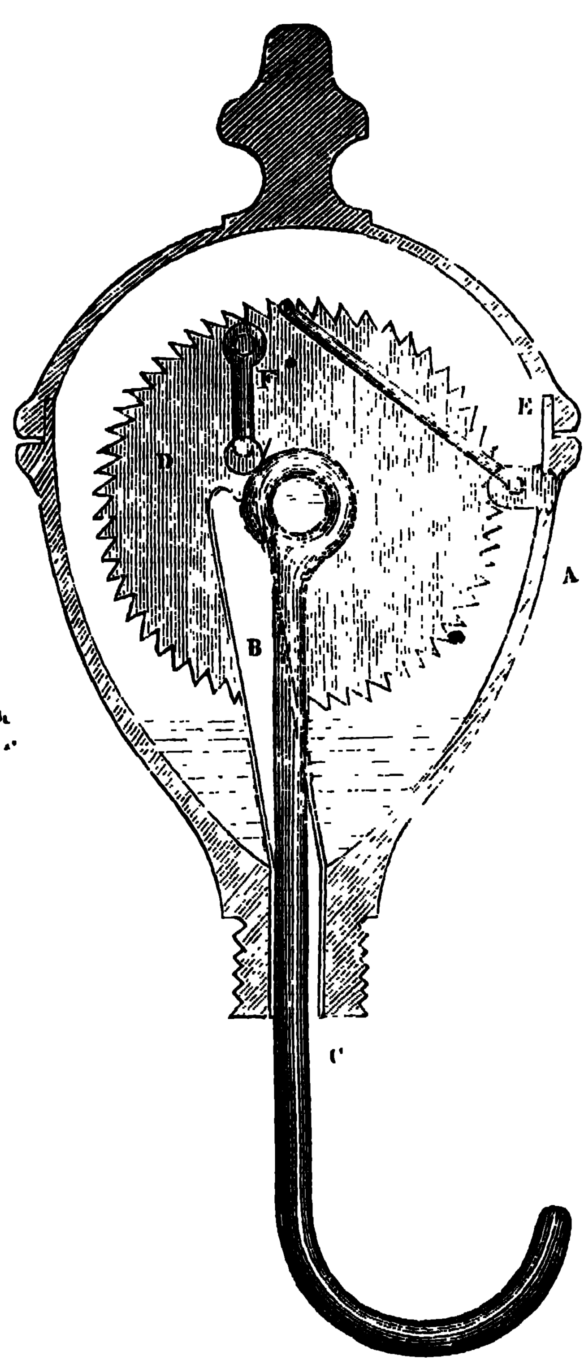
We are much pleased to observe the rapid progress which this matter has made since we first brought it before the notice of the public. On the 25th ult. Mr. Stuckey's petition to the House of Commons was presented by a member of the Government, General Sir Frederick Trench. On Friday, the 29th, a similar petition was presented

to the House of Lords, by Lord Kenyon, on which Lord Brougham rose, and bore the following powerful testimony to the peculiar excellence of Mr. Stuckey's machine. He had witnessed its performances, his lordship said, and, "whether as regarded the vast volume of water it poured forth, with unequalled rapidity, or the perfect purity of the water so poured forth, muddy and cloudy as it was when entering the filter, it was cer' ainly one of the most surprising, useful, and beautiful inventions he had everseen." On Saturday, the 30th, Mr. Hawkes gave notice of his intention to move, early next session, "for a select committee, to inquire whether the various companies supplying water to the metropolis have effectually filtered and purified the same, according to their engagements to Parliament and the public: and whether the water supplied may not be, and ought not to be, improved." We have also heard that the Duke of Wellington, the Marquess of Lansdown, Lord Radnor, and other noblemen, have expressed a strong interest in the subject.

We may take this opportunity of mentioning, for the information of several gentlemen who have applied at our office for Mr. Stuckey's address in England, that his petition to the House of Lords is dated from "32, Upper North-place, Gray's Inn-road."

## ALLEN'S PATENT LUBRICATOR.

Sir,—I send for insertion in your Magazine, should you think it worthy of a place, a drawing of my patent lubricator, by the use of which a saving of at least 50 per cent. is gained over any that has yet been tried. I have supplied the engines of the *City of Aberdeen* steamer with a set of my lubricators: she runs between London and Aberdeen, and the average duration of her passages is 40 hours; with the old lubricators, the consumption of oil was four gallons each voyage; but since mine have been at work, the consumption has been reduced one-half.




### *Description of the Engraving.*

A is the cup for containing oil; B, a tube rising about half-way up the cup; C, a lever, worked by a tappet on the shaft; D, a ratchet-wheel, worked by the lever C; E, a pall, taking into the teeth of the wheel D; F, a small piece of wire, fastened loosely on an axle projecting from the wheel, which at each revolution dips into the oil, brings up a drop, and, touching the lip of the tube B, delivers it down the tube, and thence to the machinery.

I am, Sir, yours &c.

J. ALLEN.

7, Primrose-street, Bishopsgate.
July 30, 1842.

## INSTITUTION OF CIVIL ENGINEERS.

### *Discussion on Professor Moseley's Steam-Engine Indicator.*

[Concluded from p. 40.]

*Mr. Parkes*, in corroboration of his opinion that the acting force recorded by the instrument is too low, drew attention to the circumstance that, during the period of its application (twenty-eight days), the duty performed by the engine for each 94 lbs. of coal amounted only to about $68\frac{1}{2}$ millions, and it would not be unreasonable to expect that at least 150 millions should have been the result under the different circumstances of mine and water-works engines, as 100 millions had been performed for some months by mine engines under a water load equal to 12 lbs., and a mean steam pressure of 18 lbs. per square inch of the piston. Whereas, if the water-load of 11 lbs. at Old Ford was overcome by an amount of force little exceeding 12 lbs. per square inch, a proportionate increase of duty ought to have resulted, but such was not the case.

*Mr. Parkes* then proceeded to comment on the phrase "effective power," which he understood from Professor Moseley as significant of the force of the steam, or piston pressure, measured by his instrument. He thought that phrase more strictly applicable to the amount of power given off by the engine, when ascertained, as it might be in the case of pumping engines, by the weight raised; or as it could only be determined on rotative engines driving machinery, by a dynamometer applied at the extremity of the crank shaft. He would illustrate this by an example. There was at Birmingham a corn-mill belonging to Mr. Lucy, worked by an excellent engine of forty horses power, made by Messrs. Boulton and Watt. This engine had a fly-wheel weighing 24 tons, and nine pairs of stones were driven, besides dressing-machines. Mr. Lucy had taken out a patent for an apparatus as a substitute for the fly-wheel, which had been removed. The engine so altered now drives ten pairs of stones, under the same pressure of steam, and with the same consumption of fuel as before. Thus, what he should denominate the "effective power" of the engine was increased, by this simple change, eleven per cent. Yet, Professor Moseley's instrument, or any other indicator, would have exhibited, both before and after the alteration, the exertion of a precisely equal force on the piston.

Neither did the Professor's instrument register the *absolute*, or what Professor Whewell had denominated the "*labouring*," force of the steam on the piston of an engine, as it made no deduction of the amount of force, whatever it might be, which was necessarily expended in overcoming the resistance opposed by the uncondensed steam. Its construction permitted it only to record the difference of these amounts. For these reasons he could not regard the instrument as likely, even when made trustworthy, to become of that utility to engineers which was the Professor's aim and hope. There was a greater need of an accurate dynamometer capable of showing the effective power of an engine whilst in regular work, and he was happy to say that this desideratum had been supplied by Mr. Davies of Birmingham, by whose permission he would take an early opportunity of describing to the Institution the construction and efficacy of the instrument.

It was very important that a self-registering machine should be made, capable of recording the mean steam pressure operating throughout a stroke of the engine, but it was still more important that this registration should be accurate; and he hoped that the remarks which had been made would only urge Professor Moseley to further investigations, and induce him to enlarge as much as possible the useful powers of the instrument.

*Professor Moseley* observed that when a body passes from a state of rest, through a state of motion and into a state of rest again; or from a state of motion at a given velocity through a state of motion at a different velocity, and back to its first velocity again; then is the work which must be done upon it by the moving power the same in amount, whatever may have been the velocity thus intervening between the two states of rest or of equal motion of the body, provided that the resistance opposed to its motion, and the space through which that resistance is overcome be in all cases the same.*

In Mr. Wicksteed's engine the resistance thus opposed to the motion of the piston, and the space through which that resistance is overcome at every stroke, are thus constantly the same (or in other words, the work done upon the resistance is the same at every stroke of the engine), and the piston passes at every stroke from a state of rest, to a state of rest again: it follows therefore by the above well-known principle of "*vis viva*" that the work done by the steam, as the moving power upon the piston of the engine whilst it completes a stroke, is the

* This is a principle well known to mathematicians as resulting immediately from the principle of "*vis viva*," and is as old as the days of D'Alembert: it appears first to have been applied to questions of practical mechanics by MM. Coriolis and Poncelet.

same, whatever may be the velocity communicated to it, and to the mass which it carries with it, at any period of the stroke.

It is true that to put the piston, and the mass carried along with it, at first in motion, a pressure greater than the resistance is required, and therefore greater than the mean pressure necessary to complete the stroke: a pressure equal to the resistance would only bring it into the state of rest bordering upon motion; to cause it to pass from this state of rest to a state of motion, more pressure is required, and the more as the velocity to be acquired, whilst it moves through a given space, is greater—or in other words, in order to communicate any given velocity to a body whilst it moves through any space, there must be an excess of the work done by the driving pressure through that space, over that expended upon the resistance through that space; but all this excess is accumulated, and unless the steam pressure be afterwards made less than the resistance, or unless the steam be afterwards expanded through a distance dependent on the amount of this accumulated work, so that it may expend itself in overcoming the surplus resistance through that space, then the piston will strike upon the cylinder bottom.

This principle may be illustrated by an example: suppose that the load upon the piston of an engine is 10 lbs. per square inch, and that the steam is admitted at a pressure of 15 lbs., it is evident that, by reason of the excess of 5 lbs. pressure of the steam above the load, the velocity of the piston will be made continually to increase until the steam is cut off, and afterwards, so long as the steam pressure exceeds the load, or until by its expansion the steam pressure is reduced to 10 lbs. per square inch. Up to this point the velocity of the piston and of the mass moving with it will continually have been increasing, a great momentum will therefore have been acquired by it, and this momentum will carry it on to the completion of the stroke; although, after this position is passed, the steam pressure will be less than the load, and would by itself be insufficient to move it.

In other words, the work done by the steam upon the piston will have continually exceeded that expended on the load up to this period of the stroke, and the surplus will have been accumulated in the moving mass,* which surplus work will carry on the piston to the end of the stroke, when a cylinder full of steam will be delivered of greatly less pressure than the load. If the steam had been worked at full pressure, it is evident that at every stroke a cylinder full of steam would have been discharged of the same pressure as the load. In this consists, therefore, the advantage of working expansively.

It is evident that the piston acquires its maximum velocity at the point where the steam pressure becomes equal to the load, and that the engineer by the manipulation of the steam valves produces that adjustment by which the velocity acquired by the piston at this point (or the work then accumulated in it) is caused to be just sufficient to carry on the piston to the end of the stroke, but without striking the cylinder bottom: it is moreover evident that the greater this maximum velocity can be made, the farther the piston will be carried beyond the point where the steam pressure is equal to the load, and the less will be the pressure of the cylinder full of steam discharged at the completion every stroke, or the greater the economy of the steam power.

A second illustration of the same principle may be drawn from the effect produced by a pressure suddenly thrown upon a spring. Suppose a spring which would rest deflected through an inch under a pressure of one pound. If when this spring is in an undeflected state this pressure of one pound be suddenly thrown upon it, it is certain that the spring will, at first, deflect considerably beyond that distance of 1 inch in which its deflection will eventually, after many oscillations, terminate. In fact, if it is thrown on with mathematical suddenness, the first deflection will be 2 inches. To explain this, let the pound weight be supposed to be applied gradually to the spring by dropping grain after grain of sand slowly on it. The spring will then evidently be brought to its deflection without ever passing it. Now let it be observed, that on this supposition, the first grain of sand only will have descended through 1 inch, the next descending through less than an inch, the next through yet less, and so on. Thus the work done upon the spring by each succeeding grain will be less than that done by the preceding. Yet the aggregate work done by these successive small pressures, each working through a different space, is sufficient to deflect the spring 1 inch. Now let all the grains be placed at once upon the spring. When it has deflected an inch, each grain will then have worked through an inch, and a great deal more work will, on the whole, have been done on the spring than before, indeed twice as much: but the work done before was enough to deflect the spring

* The number of units of work thus accumulated is represented in lbs. 1 foot high by $\frac{1}{2}\frac{w}{g}v^2$; whence $w$ represents the number of lbs. in the weight of the moving mass, $v$ its velocity in feet per second reduced to the piston $g = 32\frac{1}{6}$ lbs. The expression $\frac{w}{g}v^2$ is said to represent the *vis viva*; so that the accumulated work is equal to half the *vis viva*.

an inch; more than enough to deflect it has now therefore been done: that is, more has been done than has been expended. The remainder is accumulated in the moving mass of the sand and the spring, and carries on the deflection greatly beyond the position of equilibrium.

The Indicator was placed upon the engine of the East London Water-works, in the belief that by the experiments of Mr. Wicksteed the work actually performed by that engine was better known than that of any other. All the calculations and inquiries which have since been made have fully confirmed that opinion. And he had full confidence in that verification of the registration of the indicator which is supplied by its agreement with Mr. Wicksteed's estimate of the work of his engine.

In reference to the use of the term "work," Professor Moseley stated, that the various terms used by foreign engineers, to convey the idea attached to that term, appeared at length to have resolved themselves into the single term "travail;" and that of the variety of corresponding terms used in England, the term "work" was probably the most obvious translation of "travail;" that it moreover appeared to him the simplest, and the most intelligible; and that on these grounds he had adopted it.

In answer to the observation made by Mr. Parkes, suggesting the construction of an indicator which would register the work of the machine at the point where it is applied, instead of at the cylinder of the engine—

Professor Moseley stated that such an instrument would undoubtedly be very valuable, especially if it could be made to register correctly the work transmitted by a rotating shaft: but that for the purpose contemplated by him it would be entirely useless—this object was to effect, in respect to ordinary engines working under constantly variable pressures, that constant registration of the duty, the introduction and publication of which had led to so remarkable an economy of steam power in the working of the Cornish engines. No registration of the work done at the working points of the machine driven by the engine would supply a fair estimate of the duty done by the engine, a greater or less portion of the work done by the engine being lost by reason of friction in its transfer through the machine, from its driving to its working points, according as there was a greater or less complication of moving parts and rubbing surfaces intervening.

He repeated, that his object had been to determine the working qualities of the engine itself; and that he had, for this reason, specially sought to eliminate from his estimate those very influences of the friction of the machine driven by the engine, which Mr. Parkes thought it so important to include in it. It would have been a fault of his indicator, (for the purpose contemplated by it,) if it had taken any notice of the effect of that change made in the machinery of Mr. Lucy's mill which Mr. Parkes had spoken of. He had used the term *effective* work (not effective power) of the engine, to signify that excess of the work of the steam on one side of the piston, over that opposed to it by the imperfectly condensed steam on the other, which it was necessary to know, in order to estimate the real duty of the engine. It was solely for the determination of that duty that the indicator had been constructed, and the alterations which Mr. Parkes had suggested would have subjected its registration to influences which, in reference to that purpose, he had specially sought to eliminate.

*Mr. Farey* remarked, that it would lead to an incorrect appreciation of the merit of the new indicating instrument, if it were to be considered merely as a substitute for the ordinary indicator, when in fact they were two instruments, adapted to, and equally useful for, different purposes.

The new instrument does not preserve any record of the minute details of any one stroke, like the ordinary indicator, but it records a true aggregate of all the details of any number of succeeding strokes: it gives the same results as would be obtained if it were possible to have two ordinary indicator cards correctly taken, at each succeeding stroke of the engine, during the whole time of observation, by means of two indicators, one of them applied to the upper, and the other to the lower end of the cylinder; and also provided, that an accurate admeasurement of every one of all those cards was afterwards made, at ten places in the length of the card, by the scale of pounds per square inch, in the usual manner, and the amount of the ten measurements added into one sum, and then, (without averaging each card,) that such sum of each card should be carried to a continuous account, to obtain a grand sum total representing all the force that had been exerted, during both halves of every stroke, made throughout the experiment, reckoned at ten stages or portions of the length of stroke.

Such a grand total of all the cards would be a number representing the same fact as is represented by the number shown by the new instrument, and would therefore be dealt with, in each case, in a similar manner, as one of the data (viz., that representing force) for calculating (by aid of other data representing motion or space) the whole

power exerted during the time of observation.

In trying the performance of a steam-vessel, alternately up and down the measured mile in the river Thames, along the shore of Dartford Marshes, it is usual to take an indicator card from each engine at every such run; and by summing up each card, some difference will be found between them, wherefore an average of the results of several cards will give more authentic information respecting the force exerted by the engines during the whole trial, than could be obtained if one such card alone had been depended upon.

The new instrument takes cognizance of every stroke that is made by the engine during the whole time of observation; and in cases (such as in the *Great Western* steamer) where a considerable variation of force in succeeding strokes occurs frequently during such time, it is a desideratum to obtain the results which this instrument is intended to give, and which, as far as it has been tried, it seems likely to give with fidelity.

The instrument, when applied as it had been at Old Ford, becomes another mode of ascertaining performance, similar to what is reported monthly respecting the engines in Cornwall, but not exactly the same as is there called "duty," because the new instrument would show the aggregate of the unbalanced force that had been exerted, (during a given time,) by the steam to impel the piston; whilst the monthly reports show (by load in pounds, length of stroke in pumps, and number of strokes made) the aggregate of force exerted in the same time, in overcoming the resistance that the mere hydrostatic weight of the columns of water in the pumps opposes to the motion of the engine.

The instrument ought always to show more force than the reports do, and the difference between the two would be the aggregate of all the force that had been lost, during the time, by friction of the moving parts of the engine, pumps, &c.

Respecting that loss of force, there is no more of it than arises from such friction, from working the air-pumps, &c., and from resistance of the water; but it is wholly a mistake to suppose that any such loss is augmented by producing motion. Professor Moseley had just stated the true theory on that head, which theory was demonstrable mathematically, and admitted of no question.

It would be needless to go further into what had been so well explained, except to observe that the theory applies without the least abatement, or modification by incidental causes, to the case of any machine which, like a steam-engine, regains the same state, as to rest, (or as to motion,) at the end of the time of observation upon it, as the state in which it was at the commencement of that time; and the theory shows that, in such a machine, no part of the force exerted upon it, (or exerted by it,) can have been expended, or lost, in producing motion, whatever may be the number or the extent of changes or variations in velocity of motion that the machine had undergone during the time of observation; for although force must be exerted to produce motion from a state of rest, yet all force that is so exerted will be rendered back again, when the motion which was produced has ceased, and the state of rest regained: in the steam-engine, that is the case at the termination of every half stroke.

Respecting trials by means of the smallest force of steam, which will just press the piston of a pumping-engine slowly down in the cylinder, or cause the engine to come creeping in-doors: they are not much to be depended upon, as evidence of the force that is actually lost in overcoming friction; first, because no steadiness of exhaustion can be kept up beneath the piston, nor steadiness of steam above the piston, whilst the engine is so treated, and also because the counterweight of engines in Cornwall is not apportioned with any great nicety. In general, they are worked with more counterweight than is requisite, and but little loss is occasioned by so doing; for if the counterweight is unnecessarily great, so as to carry the engine quick out of doors, (that is, to cause the pump-rod to descend briskly,) then the equilibrium valve is closed sooner, and therefore retains more steam between the top of the piston and the cover of the cylinder, in what has been called the steam cushion, which stops the descending motion of the pump-rod; and, in consequence of more steam being reserved in such cushion, to go towards the supply for the succeeding stroke, that increase in the reserved steam compensates in part for the waste of force occasioned by the redundancy of counterweight, which caused the quick motion.

Mr. Farey had received from Mr. John Taylor indicator cards of Taylor's engine at the United Mines; one card was taken soon after it was first set to work, with an extravagant counterweight, and another card was taken immediately after several tons of balance had been added, without alteration of the load of water in the pumps: balance in Cornwall is contrary to counterweight, so that adding balance effects a reduction of counterweight. Now, if an attempt had been made to ascertain the friction of that engine by trying what strength of steam

would cause the engine to creep in-doors, the day before the balance was added, the friction would have appeared, (by that mode,) to have been 3 lbs. or 4 lbs. per square inch greater than it would have appeared to be after the balance had been added; although that was an extreme case, not likely to occur often, yet errors in the imputed amount of friction, to the extent of 1 lb. or 1½ lb. per square inch, would be continually made, if dependance were to be placed on that mode of trial of engines working with so much counterweight as they may happen to have.

The friction of modern engines in Cornwall, including that of their pit-work and pumps, and the resistance of the water, he believed would not be found materially, if any, greater than was the case in Mr. Watt's old engines, when the depth of the mines was not half as great, and the weight of moving parts not one-third as great; for the improvement in pit-work and pumps, and engine-work, had kept pace with that increase of depth and weight.

The pump-rods are hung more truly perpendicular, and the lengths of timber for the rods are better jointed, so as to cause them to hang straighter in the pit whilst working, and avoid lateral vibratory flexure, and therefore the rods rub less against their guides; the plungers are set truer, and, being of large diameter, have less rubbing surface in proportion to their contents, the lifts being higher, and short lifts being avoided: these, and many other improvements, tend to reduce the friction in proportion to the force exerted.

The small quantity of steam expended, and consequently of water injected into the condensers, as well as better joints to prevent leakage of air into the exhausted parts, reduces the power required to work the air-pump to a smaller proportion of the power exerted by the engine than formerly. And, in particular, the valves and water-ways through the pumps are made more open than formerly, so as to diminish the loss of force that is occasioned by resistance of the water; that loss of force by resistance increases as the square of the velocity of the motion, when loss of force by mere friction does not increase by increase of that velocity. He believed few large engines in Cornwall, which are making what is now thought tolerably good performance, lose more than at the rate of 3 lbs. per square inch of the piston, by friction of their moving parts, and by resistance of the water, and by working their air-pumps, and the best and newest engines probably still less. It would, of course, be understood that he meant, by 3 lbs., what is commonly called 1½ lb., for moving the engine each way, or through each half stroke; but that is not a correct way of stating it: 1¼ lb. friction in coming in-doors, and 1¾ lb. friction and resistance of water, in going out-of-doors, would be more likely to be correct.

## LIST OF PATENTS GRANTED FOR SCOTLAND FROM 23RD JUNE TO JULY 18, 1842.

John Cox, of Gorgie Mills, Edinburgh, tanner and glue manufacturer, for certain improved processes of tanning. Sealed, June 23.

John Bould, of Ovenden, in the parish of Halifax, York, cotton spinner, for an improvement or improvements in condensing steam engines. June 23.

John Americus Fanshawe, of Hatfield street, in the parish of Christ Church, Surrey, gentleman, for an improved manufacture of water-proof material applicable to the purposes of covering and protecting surfaces, bodies, buildings, and goods exposed to water and damp. June 30.

James Boydell, jun., of the Oak Farm Works, near Dudley, Stafford, iron master, for improvements in the manufacture of keel plates for vessels, iron gates, gate posts, fencings and gratings, June 30.

Michael Coupland, of Pond-yard, Park street, Southwark, millwright and engineer, for improvements in furnaces. June 30.

Thomas Banks, of Manchester, Lancaster, engineer, for certain improvements in the construction of wheels to be employed on railways. July 6.

John Tresahar Jeffree, of Blackwall, Middlesex, engineer, for certain improvements in lifting and forcing water and other fluids, parts of which improvements are applicable to steam-engines July 6.

James Nasmyth, of Patricroft, near Manchester, Lancaster, engineer, for certain improvements in machinery or apparatus for forging, stamping, and cutting iron and other substances. July 7.

Charles Augustus Preller, of East Cheap, London, merchant, for improvements in machinery for preparing, combing and drawing wool and goats' hair. (Being a communication from abroad.) July 13.

William Revell Vigers, of Russell-square, Middlesex, Esq., for a mode of keeping the air in confined places in a pure or respirable state to enable persons to remain or work under water, and in other places, without a constant supply of fresh atmospheric air. (Being a communication from abroad.) July 13.

Gottlieb Boccius, of the New Road, Shepherd's Bush, Middlesex, gent., for certain improvements in gas, and on the methods in use, or burners for the combustion of gas. July 14.

John Hall, of Breezes Hill, Ratcliff Highway, Middlesex, sugar refiner, for improvements in the construction of boilers for generating steam. July 18.

John Elliott Fox, of Finsbury Circus, London, gent., for improvements in steam engines. (Being a communication from abroad.) July 18.

## LIST OF PATENTS GRANTED FOR IRELAND IN JUNE, 1842.

M. M. Laroche Barre, for an improvement in the manufacture of a fabric applicable to sails and other purposes.

H. B. Rodway, for improvements in the manufacture of horse-shoes.

*Erratum in List of English Patents given in our last No.*

In the title of Lady Vavasour's Patent, for "improvements in obtaining images, &c." read "improvements in machinery for tilling land."

NOTES AND NOTICES.

*The Great Northern* (launched last week at Belfast,) is the largest vessel ever built in Ireland. Her dimensions are 220 feet in length, 37 feet beam, and 26 feet deep in the hold; burden, 1,750 tons, B.M.; she is to be fully rigged as a 50 gun frigate, the length of mainmast to be 90 feet, and 36 inches diameter, mainyard 79 feet, and 22½ inches diameter in the slings, foremast 83 feet, and mizenmast 76 feet; she will be able to spread 6,400 yards of canvass. There are three decks, the upper one to be left entirely clear for action, and to be pierced for 44 guns; the windlass and capstan gear will be placed between decks. She is to be propelled by Smith's Archimedean screw, which will be 12 feet diameter, and 14 feet pitch, but the length will be only 7 feet; it is to make 88 revolutions per minute; the gearing consists of a cog-wheel 20 feet diameter, working into a smaller wheel, of 5 feet diameter, upon whose axis is the shaft of the screw. The engine power consists of two cylinders, 68 inches in diameter, 4 feet 6 inches stroke, and to make 22 strokes per minute; nominal power about 370 horses; there are to be 4 air-pumps, 19 inches diameter, and 4 feet 6 inches stroke, and cylindrical boilers. The engines are to be placed close abaft the vessel, leaving the midships clear for passengers. *Derry Standard.*

*The Great Britain* (late *Mammoth*) is not now expected to be finished before the spring of next year.

*The Montezuma Steam Frigate*—A very successful trial was made, last week, of a new steam-frigate, which has been built for the Mexican Government, and appropriately named the *Montezuma*. She was constructed at the yard of Messrs. Wigram and Green, and her engines, which are of 300 horses power, and on a similar principle to those on board Her Majesty's steam-frigates *Gorgon*, *Driver*, *Styx*, &c., were supplied and fitted by the firm of Messrs. Seaward and Capel. Her burden is 1,100 tons, but she draws no more than nine feet water when fully equipped, and is built to carry two swivel guns, 68-pounders, on the upper deck, besides the usual number of small guns. Although constructed rather for fighting purposes than for speed, she steamed at the rate of 10½ miles an hour, against tide both ways, the engines making 21 strokes per minute. A new disconnecting apparatus, for releasing either paddle-wheel, which was tried, was found to answer admirably.

*High-pressure Boiler Explosion.*—The last arrivals from Canada bring an account of an explosion on board the steamer *Shamrock*, attended with a most frightful destruction of human life. The list of sufferers, "of the *English* portion" alone, includes 43 killed, and 20 wounded. The *Shamrock* was a new boat, and built at Niagara; and her engines, which were of 32 horses power, were on the high-pressure principle. The engineer of the vessel stated, at the coroner's inquest, that, "according to the directions of the builders of the engine, he was allowed to carry 85 lbs. of steam, but that at the period of the accident there were not more than 70 lbs. of steam." [Exactly the pressure at which the *Locomotive*, now working on the Thames, is said to be worked.]

*Steam Pile Driver.*—Among the many improvements in machinery which are daily taking place, we notice with pleasure the introduction recently, at the harbour works, of a self-acting machine for driving piles. The moving power is taken from a cylinder connected with the engine erected for pumping out the water in the dock, which does its work in a most admirable manner. There are two other pile-driving machines, wrought by manual labour, in operation alongside of it, requiring nine men to each; and this self-acting machine, attended by one man, gives seven strokes for every one that the others give, so that it does the work of sixty-three men. It can be extended in the same proportion to any power. It is the invention of Mr. James Milne, engineer at the dock.—*Montrose Review.*

*The Thames Tunnel* was opened on Monday last for the first time on the Wapping side of the river, and upwards of 500 visitors, of all nations, passed through the tunnel as far as the shaft on the Rotherhithe shore. The Wapping shaft is about 90 feet in height, and is surmounted with a handsome dome, which is glazed, and light and air admitted. There are two staircases, one terminating close to the western arch, and the other leading to the eastern arch. The western arch only is opened for visitors; but the eastern one appears likely to be appropriated to the same purpose in a few weeks, and a great number of workmen are now actively employed in preparing it for the reception of the public. The erection of the circular staircases in the shaft on the Surrey side, now closed to the public, will be commenced forthwith by the contractors, Messrs. Peto and Grissell, who have completed the staircase on the Middlesex shore. The time allowed for the performance of the contract is three months, when the tunnel will be opened as a thoroughfare for foot passengers; the toll to be charged is, we understand, to be 1*d.* each person. Some time, however, must elapse before the circular staircases and inclined planes for horses, cattle, and vehicles can be formed; but the plans are already framed, and the works will be conducted with all possible expedition. The engine and pumps are constantly at work in the Rotherhithe shaft, to clear the tunnel of the accumulation of water caused by the land springs. There is a culvert under the Western arch, into which the waters are collected and pumped out, which keeps that side of the tunnel always dry, and as a current of air now passes through the excavation, the place is rendered comfortable, and by the aid of the gas lights, which are always burning, the temperature of the atmosphere is nearly the same as it is on shore.—*Times.*

*Progress of Steam Power in France.*—We find by a recent statistical return, that at the end of last year there were in France 179 establishments having steam power, containing 5,600 boilers, of which 1,889 were for the purposes of heating, and 3,511 for giving motion to machinery. There were, besides, 2,637 engines, the aggregate of which was equal to 39,779-horses power. At the same period there were 260 steam-boats, being 128 more than in 1838, without comprising those belonging to the state. The number of engines was 400, of a force equalling together 45,000-horses power. The number of passengers conveyed by these vessels was 2,500,000, being 800,000 more than in the preceding year. The increase of merchandise sent by them on freight was equally remarkable, having exceeded by more than 60,000 tons the quantity thus conveyed in 1840. The locomotives employed on the rail-roads in the departments of the Seine, Rhoue, Herault, and Loire, were in number 118, and in force upwards of 300-horses power. Of these, about 35 were of French manufacture.

*Erratum.*—Mr. Jubber requests us to state, that his patent being dated 4th June, 1842, his specification could not have been enrolled, (as stated by mistake in our last,) on the 1st December, 1841.



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# Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 992.] SATURDAY, AUGUST 13, 1842. [Price 3*d*.

Edited, Printed and Published by J. C. Robertson, No. 166, Fleet-street.

## JEFFREE'S PATENT SLIDE PUMP.

Fig. 7.

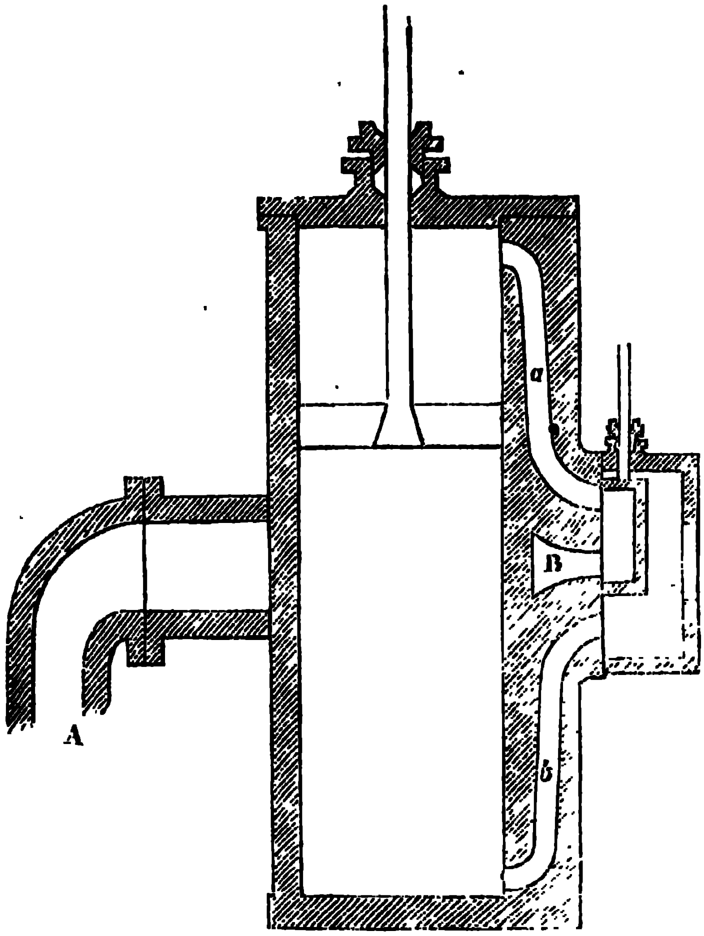



Fig. 8.

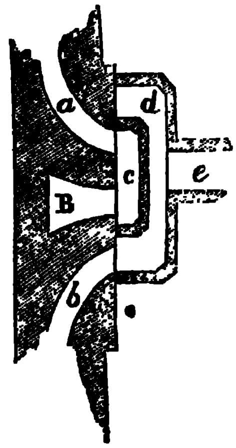



Fig. 1.

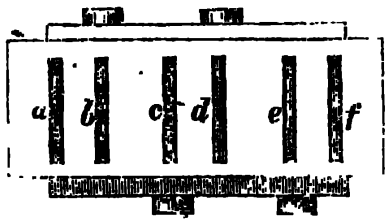



Fig. 5.

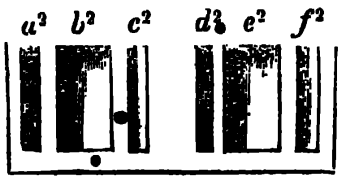



Fig. 2.

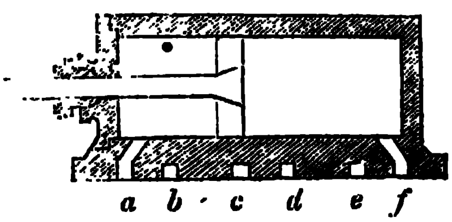



Fig. 3.

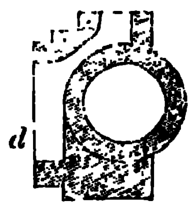
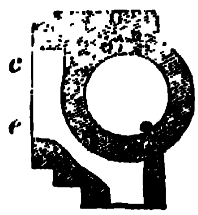



Fig. 4.



## J. T. JEFFREE'S PATENT IMPROVEMENTS IN LIFTING AND FORCING WATER.

[Patent dated 11th January, 1842. Specification enrolled 11th June, 1842.]

The improvements which form the subject of this patent are remarkable for the union which they exhibit of great ingenuity of contrivance, with extraordinary simplicity in the working results.

The chief improvement consists in dispensing, in lifting-pumps, with the moveable valves in common use, and avoiding thereby the great liability to derangement to which such valves are necessarily subject. Mr. Jeffree's plan for this purpose presents an obvious analogy to the sliding-valve system adopted of late years in steam-engines; but differs very much from it in its details.

"To the side of the barrel of the pump, he affixes a plain-surfaced piece of wood or iron, of an oblong form, as represented by fig. 1, in the accompanying engravings, having six rectangular apertures in it, *a*, *b*, *c*, *d*, *e*, *f*, communicating with different passages made through the body of the said piece, and represented in the sectional views, figs, 2, 3, and 4. The apertures *a* and *f* communicate with passages which lead into the barrel of the pump, one on each side of the piston, as shown in the horizontal section, fig. 2; the openings *b* and *d* lead upwards to the discharge-pipes, as shown in the vertical section, fig. 3; while the apertures *c* and *e* lead downward to the well, or other source of supply, as represented in the sectional view, fig. 4, (the discharge and supply pipes being omitted in the engravings, as unnecessary to a clear comprehension of the invention.) To the plain-surfaced piece fig. 1 is adapted another plain-surfaced piece, fig. 5, (the two pieces being ground true, to fit each other exactly,) and having six rectangular apertures, $a^2$, $b^2$, $c^2$, $d^2$, $e^2$, and $f^2$, leading to passages in the said piece 5, which communicate with each other in the manner shown in the horizontal section, fig. 6. To the outside of this piece, 5, is attached a rod, *g*, as shown in fig. 6, which rod is parallel to the piston-rod, and moved to and fro simultaneously with it, and by the same power, whatever that may be. The better to preserve the parallelism of the piece 5, it may be made to slide within flanges raised on the face of the piece 1; but when the pump is short, this is not thought to be necessary.

"The action of the pump is as follows. Suppose the piston is at the bottom, or farther end of the barrel, the two pieces 1 and 5 will then be face to face, or in full contact, and the apertures and solid parts of the two faces will be in such relative positions to one another, that one of each of the three pairs of apertures, the pair leading to the barrel, (*a* and *b*,) the pair leading to the discharge-pipes, (*b* and *d*,) and the pair leading to the well, or other source of supply, (*c* and *e*,) will be open, and the other shut. The piston being now raised or drawn out, the vacuum produced causes the water to flow up from the well, or other source of supply, through the aperture *e*, in the face of the piece 1, into the aperture *e*, in the face of the piece 5, whence it passes through the aperture *f*, fig. 1, into the barrel of the pump; by the return stroke of the piston, the water which was raised by the preceding stroke is expelled from the pump-barrel, through the apertures *f* and *d*, into the upward discharge-pipe connected with the opening *d*; while, at the same time, the vacuum produced behind the piston causes the water to flow up from the well, or other source of supply, and pass through the apertures *b* and *a* into the barrel, ready to be discharged at the next up or outward stroke of the piston. At every subsequent stroke of the piston there will, of course, be always one body of water supplied to the pump-barrel, and one discharged from it, and that alternately, at opposite ends of the piston; and if the discharge-pipes connected with the openings *b* and *d*, are made to empty themselves into one common mouth-piece, the water will be discharged in one continuous stream."

A pump of this sort is obviously liable to no other derangement than what may occasionally arise from some of the apertures being obstructed; but in that case the evil can be at once got at, by simply taking off the upper piece, fig. 5, and when the obstruction is removed, the pump becomes as good as ever.

For water-closets on board ships, the patentee considers this pump to be particularly well adapted; since it requires no supply cistern, the space required for which is often an insuperable objection to the use of these conveniences at sea.

Another plan of construction, more nearly resembling the slide-valve used in steam-engines, and which might, in fact, be advantageously substituted for it in many instances, as it would do entirely with the ordinary jacket and stuffing-box, is shown in fig. 7 and 8.

Fig. 7 shows the pump as it would be, if fitted with a slide-valve of the ordinary construction; and fig. 8 shows the sort of valve which the patentee proposes to substitute for it. In a pump of the

Fig. 6.

$a^2$ $b^2$ $c^2$ $d^2$ $e^2$ $f^2$

construction of fig. 7, the water rising in the pipe A flows by a curved passage carried round the barrel of the pump to the opening B, whence it passes upwards, through a channel, *a*, left open by the slide, into the barrel; whilst, at the same time, the water supposed to be left in the lower part of the barrel by the preceding stroke is forced up the passage *b*, and into the casing of the slide, whence it is discharged through the orifice C. The improved slide-valve, represented in fig. 8, *is all in one piece*, and of an oblong form, with a plain face, but curved a little if necessary, so as to fit exactly to the barrel of the pump. In the centre of the face there is a recess, *c*, of sufficient width to cover the two passages *a* and B, and behind it there is a curved channel, *d*, cut out in the body of the slide, lengthwise, and terminating at top and bottom in apertures in the face of the slide, which, as the slide is moved up and down, (by parallel connectors with the piston-rod, in the usual manner,) communicate alternately with the passages *a* and *b*, allowing the water to flow through *c a*, up into the pump-barrel, and through *b d* into the discharge-pipe *e*.

The patentee describes, also, a forcing-pump, and a double-acting pump with two concentric barrels, both very clever, and apparently most efficient machines; but a description of these we must reserve for some future Number.

## MR. BOOTH'S NEW SYSTEM OF PROPELLING.*

Sir,—I have read a pamphlet entitled "The Theory and Practice of Propelling through Water, &c. &c. by Henry Booth, Liverpool," and after giving it an attentive consideration, I have thought some brief remarks may not be inadmissible into your valuable journal.

The writer commences by stating fairly enough, "the theory of the comparative resistance of water at different velocities propounded by various writers on mechanics in the last quarter of a century, and recognised by engineers and men of science in the present day." He states correctly the purport of Mr. Seaward's essay, which shows from facts and experience the enormous cost at which *a small increase in speed is accomplished*, a result which is in accordance with that theory; but, "demurring entirely" to it, he proceeds to state the ground of his objection.

Mr. Seaward gives in a tabular form the result of his own investigations as a practical man into the actual working of steam vessels, deducing from observation and experience the quantum of mechanical power required to move vessels of a given tonnage through the water at different degrees of velocity. A few extracts from Mr. Seaward's table are quoted. The *stated burthen* of the vessel is supposed to consist both of engines and cargo, and to be *kept equal and uniform* by diminishing the weight of cargo as you increase the weight of the engines.

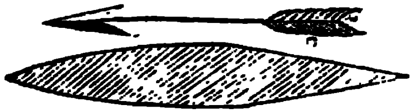
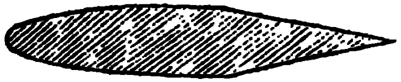
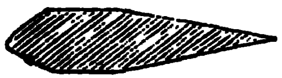
"With a vessel of 1200 tons so regulated 30 horse power will give 4 miles.

| | | | | |
|---|---|---|---|---|
| | † 112 | .............. | 8 | .. |
| | 250 | .............. | 10 | .. |
| " With a vessel of 955 tons | 30 | horses will give | 5 | miles an hour |
| ,, ,, | 240 | .......... | $10\frac{4}{5}$ | .... |
| " With one of 910 tons | 36 | horse will give | 6 | .... |
| ,, ,, | 290 | .......... | $11\frac{1}{5}$ | .... |
| " With one of 740 tons | 30 | .......... | 6 | .... |
| ,, ,, | 240 | .......... | 11 | .... |

* We have already given an account of this system, and stated in a general way our reasons for considering it entirely fallacious: but what has before appeared in our pages may be considered as only a suitable introduction to the more elaborate and complete examination which we now publish from the pen of a gentleman, whose name, if we were at liberty to mention it, would be at once recognized as that of one of the highest living authorities in all matters relating to steam navigation. We are glad to find that the writer's opinion of Mr. Booth's system coincides so entirely with our own.—Ed. M. M.

† An evident mistake.

## COLONEL BEAUFOY'S TABLE.

| FORM OF BODY. | FEET PER SECOND. | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|  | 0·2229 | 0·9245 | 2·1042 | 3·751 | 5·856 | 8·403 | 11·381 | 14·777 | 18·577 | 22·776 | 27·36 | 32·31 |
|  | 0·3287 | 1·2712 | 2·7565 | 4·726 | 7·128 | 9·917 | 13·052 | 16·498 | 20·213 | 24·172 | 28·34 | 32·69 |
|  | 0·2845 | 1·1348 | 2·5147 | 4·389 | 6·724 | 9·488 | 12·657 | 16·202 | 19·927 | 24·111 | 28·59 | 33·35 |
|  | 0·2836 | 1·1392 | 2·5434 | 4·462 | 6·867 | 9·730 | 13·030 | 16·741 | 20·828 | 25·296 | 30·11 | 35·25 |
|  | 0·3798 | 1·4949 | 3·2870 | 5·705 | 8·703 | 12·238 | 16·275 | 20·779 | 25·712 | 31·06 | 36·77 | 42·83 |
|  | 0·2617 | 1·0539 | 2·3457 | 4·107 | 6·309 | 8·927 | 11·935 | 15·310 | 19·02 8 | 23·023 | 27·42 | 32·05 |
| Man of the Six Experiments. .... | 0·293 | 1·169 | 2·592 | 4·523 | 6·931 | 9·784 | 13·055 | 16·718 | 20·712 | 25·073 | 29·76 | 34·75 |

Charnock says the "sailing of a vessel depends on a myriad of circumstances."—No table founded on actual performance of different vessels can be minutely accurate; and this of Mr. Seaward, except in the second instance, (which differing so materially from the three following must have been misquoted,) gives practical confirmation of the received theory. The results of the experiments of Colonel Beaufoy, although, they will doubtless be familiar to your scientific readers, may with propriety be submitted here for inspection, and the accompanying extract from his table will show how nearly practical experiment and theoretical deduction coincide. "The scale on which these experiments were conducted, the extreme accuracy observed, the ample means possessed by, and the extraordinary devotedness to the science, and the perseverance of the experimentalists are certain guarantees that the results may be depended upon."

The law in hydrostatics governing the theory of resistance, is that, "if any body move through a fluid at rest—or the fluid move through the body at rest, the force or resistance of the fluid against the body will be as the square of the velocity and the density of the fluid." And what can be more plain than the demonstration? "For the force or resistance is as the quantity of matter or particles struck, and the velocity with which they are struck. But the quantity or number of particles struck in any time are as the velocity and density of the fluid—therefore, the resistance, or force of the fluid is as the density and square of the velocity." Founded on this law of *quadruple resistance*, that of *octuple power* is the necessary consequence, for in a current of 10 miles an hour, double the number of particles must impinge and pass the vessel, as in one of 5. The velocity and density of the fluid are both doubled, the square of which gives the *octuple ratio.*

To this law and its consequences Mr. Booth demurs, and for the purpose of testing it, he caused a trough 26 feet long. 3 feet wide, and 2 feet deep to be constructed, which was supplied with 18 inches depth of water.

As many of your readers may not have access to the book, I must trespass on your space by giving his experiments.

"No. 1. A weight of 2 lbs. falling 7 feet 6 inches drew the boat 7 feet 6 inches in 6 seconds, (the cord attached to the boat, and the cord attached to the weight, passing round pulleys of the same diameter.")

"No. 2. Other things being the same, I increased the weight, till it fell 7 feet 6 inches in 3 seconds, the weight being then 8 lbs."

This, as Mr. Booth says, accords with the "quadruple ratio, or of double speed requiring *octuple power*."

But Experiment No. 3 gives vastly different results. This was so arranged, that the weight or power should always move through the same space in the same time; the cord attached to the boat was passed round a pulley twice the diameter of the pulley round which the cord attached to the weight was passed: the boat would, consequently, move through the water 15 feet, while the weight, as before, moved 7 feet 6 inches.

"By repeated trials," Mr. Booth says, "I found that 5 pounds sufficed to draw the boat 15 feet in 6 seconds, the said weight falling 7 feet 6 inches in the same time;" "thus by changing the mode of applying the power, 5 pounds become as effective as 16." "That is, 2½ times the power, moving through the same space in the same time, was required to draw the boat double the space in the same time, or twice the distance at twice the speed."

Experiment No. 4 *confirms* the "quadruple ratio." No. 5 and 6 accord with No. 3. *And with these six experiments*, (he says he made others of a similar kind, with which he will not trouble the reader,) he sets up the doctrine, that all received opinions founded on theory and practice are erroneous.

On the new theory, 5 lbs. are as effective as 16 on the exploded one. According to it, a boat placed in a tide-way of 5 miles an hour, with a power on board of 30 horses, which exerted would just enable her to stem the current and hold her own, would be driven *against* this tide of 5 miles another 5 miles, by the addition of 45 horses; 45 is, therefore, to effect the same speed in a current of 10 miles that 60 has done in one of 5!

Now, let us imagine, for the sake of illustration, that a 30-horse engine, by increasing the effective force of the steam, may be converted at pleasure into a 60, 120, and 240-horse power. Making the same number of revolutions, *double* the quantity of steam *must* be expended in the 60 that is required for the 30; and at double speed, 10 miles an hour instead of 5, *four times*, making it an engine of 120 horses. But there is yet another

difficulty to be encountered. At 10 miles, *there must be double resistance* from "twice the number of impinging particles;" the power must therefore be again doubled, resulting in the "quadruple ratio."

Mr. Booth's experiments 1, 2, and 4, confirm the received law; but 3, 5, and 6 present an extraordinary anomaly, for, according to these, *twice* the *distance* and *twice* the *speed* are acquired by a little more than *twice* the power; and 5 lbs., by changing the mode of applying the power, become as effective as 16, under the old system, which his other experiments confirm. This astounding result Mr. Booth infers to be in consequence of the loss occasioned by the more rapid falling of his weight, or motive power, in the one case than in the other; and by changing its speed from 15 feet in 6 seconds to 7 feet 6 inches in the same space of time, he gains in the ratio of 16 to 5. Now, it is perfectly true, as Mr. Booth says, "if you increase the velocity of descent, you diminish the effectiveness of weight as a power, and, carried to the point indicated by the law of gravitation as affecting falling bodies, a weight has no power at all." But what is this law? "A heavy body falling freely will pass through a space of 1,208 feet the first second, and then attain an increased velocity, in the inverse ratio of the square root of the height from which it falls: in 4 seconds it will have acquired 16; in 9 seconds, 24; in 16, 32; and in 25, the rate of 40 feet in a second. The highest velocity in the experiments 1, 2, and 3 is 15 feet in 6 seconds, the lowest 7½, making 7½ feet the difference, or one foot and a quarter per second to be deducted for loss by the increased velocity of descent, from the average speed of a body falling six seconds. This is hardly sufficient to account for a gain of upwards of 300 per cent! Would a body, falling through a given space at the rate of one foot and a quarter in a second, raise a greater weight double that distance, the cord attached to it passing over a pulley of double size, than it would passing through double space in the same time, both pulleys being alike? Or would the difference be more than the smallest fraction, even although the falling body should be feathers, and the one raised lead?

There must have been some *screw loose*—some *mistake in a figure*— in the experiments. They are so contradictory in themselves, and so utterly at variance with *theory*, established with mathematical certainty, and *practice*, as proved by close observation, and the most elaborate experiments, that I must be excused for taking with distrust assertions in direct opposition to my own assent to a Q. E. D., and the authority of such men as Colonel Beaufoy and Mr. Seaward—indeed, of all "engineers and men of science in the present day." The resistance to a body passing through the water is resolved by writers on naval architecture into three distinct causes — *head pressure, lateral friction*, and *stern pressure*. The first of these, caused by the water impinging the bow of the vessel, must necessarily be in the ratio of the number of particles impinging, and their velocity, and, of course, must be quadruple at double speed. It constitutes by far the greater portion of the whole resistance. *Lateral friction* is caused by the water passing in contact with the sides and bottom of the vessel, and will be in direct proportion to the number of particles so passing. By an inspection of the diagram, it will be found that it constitutes but a small proportion of the resistance; the forms presenting the greatest surface for its action, from having a better entrance, are those that move most easily through the water. *Stern pressure* being the tendency to a vacuum caused by the passage of a body through a fluid, with the fine lines adopted for the after bodies of steamers, and at their slow speed must offer but little obstruction. A cannon-ball, on first leaving the piece from which it is discharged, is much retarded by it, its motion being so rapid, that the air cannot rush in with sufficient speed to fill up the vacuum; but at 10, or even 16 miles an hour, the water readily flows in—its ratio, no doubt, will be double at double speed.

Suppose, by way of approximation, we divide these resisting powers in the following different proportions—head pressure, increasing according to the squares of velocity, and friction and stern pressure in direct proportion, following Col. Beaufoy's table of *actual resistance* at different velocities. [See Table next page.] At slow speed, it will be seen that friction and stern-pressure have a much greater *relative* effect than at high, on

the velocity being increased to the practical desideratum of 12 miles an hour,

TABLE.

| | 1 mile. | 2 miles. | 3 miles. | 4 miles. | 5 miles. | 6 miles. | 8 miles. | 10 miles. | 12 miles. |
|---|---|---|---|---|---|---|---|---|---|
| Colonel Beaufoy's first experiment.... | 0·2229 | 0·9245 | 2·1042 | 3·751 | 5·856 | 8·403 | 14·777 | 22·776 | 32·31 |
| By the quadruple ratio ........... | | 0·8916 | .... | 3·698 | .... | 8·416 | 15·004 | 23·424 | 33·71 |
| * 75 per cent for head pressure, &c..... | | 0·7802 | .... | 3·235 | .... | 7·369 | 13·120 | 20·496 | 29·41 |
| 80 per cent. do. | | 0·8032 | .... | 3·328 | .... | 7·575 | 13·503 | 21·081 | 30·25 |
| 90 per cent. do. | | 0·8470 | .... | 3·513 | .... | 8·140 | 14·253 | 22·252 | 31·93 |

* Thus, 75 per cent. of 0·2229 for head pressure = 1672 × 4 = ·6688
25 do. for friction and stern pressure 557 × 2 = 1114
0·7802 &c. &c.

head-pressure increasing four-fold, while the other causes of retardation are only doubled; the division of nine parts for the one, and the remaining tenth for the other two, approximates very nearly to the practical results, which it would otherwise be difficult to reconcile. It would thus appear, that "the force or resistance (from head-pressure) is as the quantity of particles struck, and the velocity with which they are struck," and that friction and stern-pressure are fixed quantities, increasing in a direct ratio.

Having disposed of the "Theory," I may be allowed a few remarks on the "Practice" as involved in the "improved method of applying mechanical power to steam navigation."

To drive a boat at any given speed, say from 10 to 12 miles an hour, the calculation in ordinary steamers, is to allow a loss of *one-third* of the power applied. Let us suppose, however, that Mr. Booth's propeller possesses such advantages as to lose only *one-fourth*—to give 10 miles speed to the boat, it must therefore go through a space of 66,000 feet in an hour, or 18⅓ feet in a second, which, whether given in short, quick strokes, or long, slow ones, must require about 90 percussions in a minute, 90 × 12½ × 60 = 67500. But he says, the piston of his engine moving at the rate of 2½ miles an hour, will give 31¼ miles speed to his propeller. Take, however, 30 miles speed as the average, and it is obvious that there must be a loss of more than half from the want of resistance; for unless the irregularities are such as to make a tremendous jerking motion, 15 miles is as much as can be expected at any one moment of time; and that subsiding to 8·30 times in a minute, will not be over-pleasant. The piston of an engine of 4 feet stroke moving 2½ miles an hour, would give 33 revolutions in a minute; 33 × by 12½, the length of the stroke of the propeller, would give less than 5 miles an hour, whereas 12½ would be required; the residue must therefore be made by the "concentration of power." Few engineers will agree with the writer in his principles of *concentration*. Does he suppose that the power absorbed and concentrated in a fly-wheel is any greater when given out at a single impulse, than if divided into ten? Or in other words, that any more power can in any possible way be obtained from the recipient than is communicated to it? If this can be effected, we need look no further for perpetual motion. If his 200

horse engine can be made to give out more than 200 horse power "by a slow succession of rapid strokes," or in any other manner, the effect must be greater than the cause, and perpetual motion the inevitable result. The writer does not appear to take into consideration the resistance and friction that will be opposed to the returning frame-work and open propelling-plate; 10 miles an hour is the speed at which the vessel is supposed to go; say 880 feet in a minute; the stroke must be repeated 33 times × by $12\frac{1}{2}$ = 412, or 1292 feet speed for the returning propeller: this, too, supposing each concentrated stroke of $12\frac{1}{2}$ feet to drive the boat $26\frac{1}{2}$, in which I apprehend he will be greatly disappointed: 1292 feet, however, in a minute, on the *octuple* ratio, which he must pardon me for still believing in, would be no inconsiderable drawback even from an open valve-plate.

It is unnecessary to dwell upon the practical difficulties that would be opposed to such an application of power. What material could possibly be made to stand the shock of the concentration of a 500 horse power into a single impulse of 5000? The best iron, and the most perfect workmanship, are already in requisition for the cranks and shafts of engines as now constructed, to meet an *uniform resistance*. What reasonable belief can there exist that the quality of the material can be so improved, or the quantity so increased, and, necessarily, the skill to forge such masses so much advanced, as to meet so great a demand for additional strength, as the conversion of an uniform motion of 500 into one of impulses of 5000 would require? The tremendous friction on a cam-wheel, giving out this power in the space of 1 foot 3 inches 38 times in a minute, must be apparent to all; but how Mr. Booth arrives at the conclusion that he has not half the resistance to overcome, unless he intends to monopolize the discovery that the power of 5 is equal to 16, I am at a loss to understand. That his "engine will not be of half the usual height," and his "coals of not half the quantity," will be the necessary result of $5 \times 0 = 16$.

Your obedient servant,

O. B. F.

P.S. I have written the above before I saw your Number of 16th July. If you think it worth insertion it is at your service. I should like to call the attention of your scientific readers to the table of head-pressure, friction, &c. If the principle be correct, the exact proportions may easily be found. I have not the book at hand for references, but I think "Charnock on Naval Architecture" will give the requisite information.

O. B. F.

## THE IRON STEAMER "QUEEN."

Sir,—As your valuable publication is almost the only means through which any works of art, either of merit or otherwise, can be brought fairly before the scientific world, I beg the favour of your inserting the following statement of the dimensions and performance of a new iron steamer recently started upon the Thames.

The vessel I refer to is named the *Queen;* and, so far as a judgment may be formed of her capabilities from a careful inspection of her, inside and out, and the few trials of speed that have yet been made with her, (more than one of which I have had the pleasure of witnessing,) I am of opinion that she will fully merit the high name her owners have selected for her. A more beautiful specimen of a light river steamer, whether as regards design or workmanship, I have never before seen.

The vessel was designed by, and built under, the immediate superintendence of Mr. Edward Pasco, (a gentleman well known on the river, and of considerable promise as a shipwright;) and the engines, manufactured by the eminent engineering firm of Messrs. George and Sir John Rennie, of Blackfriars. She is 160 feet long, between perpendiculars; of 16 feet 6 inches beam; 8 feet 9 inches deep; and draws about 4 feet 3 inches water. In her engines there is nothing new, but they are constructed on certain known and well-approved principles, which have produced a most efficient result; and I feel confident this will be at once admitted, by all competent judges, when I state their performance. On Saturday, (the 6th instant,) her owners were honoured by the Lords Commissioners of the Admiralty using her as the mode of transit from Deptford to Woolwich Dock-yards, when their Lordships were pleased to express, in no measured terms, the high gratification they felt on

witnessing her extraordinary speed, together with the entire absence of vibration in the vessel and disturbance of the water, although going at the rate of about sixteen miles per hour.

After landing their Lordships at Woolwich Dock-yard, her owners directed that her speed should be at once tested, by putting her in competition with about the fastest, if not the very fastest vessel on the River, namely, the *Railway*. This the party in command, (the well-known Captain Turner, for many years commander of the *Mercury*,) at once proceeded to do. The *Queen* met the *Railway* about three miles below Woolwich, turned round, and beat her considerably into Blackwall. She started again with her for Gravesend, at half-past four, and it was soon evident that the *Railway* had no chance; but as this was in some measure to be attributed to the number of passengers on board the latter, the *Queen* went on to Gravesend, with the view of trying the *Railway* on her return passage, conceiving that, at half-past six o'clock on Saturday evening, there would not be many going up. So, in fact, it turned out; and the people of the *Railway*, which started from the Terrace Pier, when passing the *Queen*, lying at the Town Pier, gave her the challenge of—"come on, we are ready for you *now*." The *Queen* started some minutes after the *Railway*, so as to give her time to call at Gray's Pier; but when the former got up to Gray's, the latter was about two miles ahead. The *Queen* then made all haste after her, making from 34 to 35 revolutions per minute, and got into Blackwall neck and neck with the *Railway*, thereby establishing, without question, her much superior speed.

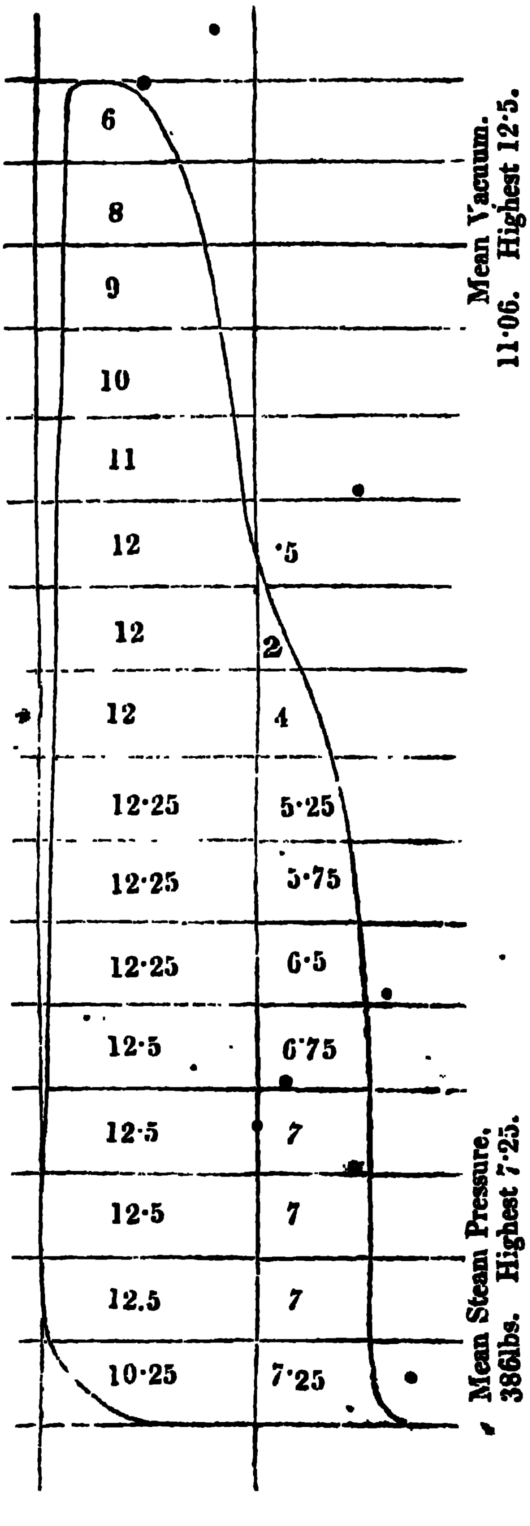
Having stated so much, Mr. Editor, allow me to remark, that I have read, from time to time, a great deal about the speed of this and that vessel; but in no one instance do I recollect noticing any statement whereby we might come at the cost of obtaining these high speeds, which, after all, is the question of most interest to the scientific reader. The cylinders of the *Queen* are 29 inches in diameter, and the length of stroke 4 feet 5 inches; the average number of strokes per minute, 34; pressure of steam in boiler, 8 lbs.; the condenser vacuum, equal 27¼ inches mercury; the diameter of paddle-wheels, 16 feet 6 inches width of ditto, 8 feet.

I enclose a diagram, taken on the 16th of July, by which your readers will see at what portion of the stroke the steam is cut off, and that the effect indicated was produced at an expense of about 6¼ cwt. of coal per hour, being, I believe, less than the average of steamers of her class.

I am, Sir, your obedient servant,
L. P.

August 9, 1842.

INDICATION DIAGRAM OF "THE QUEEN," 16TH JULY.



### PERFORMANCES OF WATER WHEELS.

The *Midland Counties Herald* contains a letter from "A Miner," in which, adverting to a statement made at the Institution of Civil Engineers that Wheal Friendship and Wheal Betsy water-wheels were, in July 1841, performing 69, 51, 54, 56, 72, 67, and 57 per cent., or on an average 61 per cent. the writer makes the following remarks:—

"I have been frequently at these mines in the course of the last thirty years, and have paid particular attention to the duty performed by the wheels, in order to make correct calculations for erections of my own; but at no time, could the best of these pumping engines perform 40 per cent. A recent practical trial to a wheel, proved that 200 gallons of water cannot be pumped 20 feet high with a 50-foot water-wheel, using 200 gallons to peform one revolution.

"The tables in the *Practical Miners' Guide* may be depended on, found on page 88, made up as follows, viz.:—

18,750 lbs. of water performing a revolution on wheel 46 feet diameter will draw a 12-inch lift 113 fathoms 6-feet stroke.

Thus—113 fms. of 12-inch pumps,

| | lbs. | | lbs. |
|---|---|---|---|
| | 33,280 × | 6 = | 199,680 |

Performed with 18,750 × 46 = 862,500
About 23½ per cent.

"I should be glad to know—How the water was measured? Particularly the 'Old Sump Wheel,' 51 feet diameter, 10 feet broad, the water poured into its buckets 5,632 gallons per minute.

"The mode of measuring running water by width, depth, and time, is not a satisfactory way. The most correct way for measuring water is to measure the contents of a reservoir in number of cubic feet. When ascertained—First, Fill the same with water, observing the required time by minutes and seconds, which will give the number of cubic feet per minute. Secondly, Work the water down by counting the number of revolutions performed by the wheel until the reservoir is empty, which will give the number of cubic feet to each revolution.

"The water may also be measured by the contents of each bucket, and counting the number. There is nothing intricate in calculating the real duty of a wheel pumping water: the boxes or plungers applied for that purpose should be in good working order, and the water pumped should not only be measured by the area of the cylinder or piston and length of stroke, but also proved by measuring the stream discharged at the head of the lift, by having a small cistern or some other vessel prepared for the purpose."

### THE CRANK QUESTION.

Sir,—Although I feel much obliged to your correspondent, R. W. T., for saying he does not doubt my veracity, in relating the experiments made by me, connected with the inquiry into the action of the crank, particularly the last experiment; nevertheless, the nature of that experiment, the limitations within which it was confined—the very terms of it rendering a practical trial unnecessary—makes me doubt whether I am much indebted to his kindness for this courtesy. The more so, that I find he has not changed some of his bad habits, and does not hesitate, when it answers his purpose, to give garbled extracts from my papers, and make believe he cannot understand me (as I before had occasion to remark), when he thinks it more convenient to do so than to refute my arguments. For example, had he not unfairly stopped short in the extract which he makes respecting the first matter he touches on, it would have been seen that I contended for a loss of power equivalent to 20; and have *not*, as he alleges, abandoned that point, as untenable. Would it not have been more to his credit, to use his best endeavour to prove I was in error in doing so?

R. W. T. is beating a retreat, I perceive. He wishes, like some others of your correspondents, when hard pressed, to shift his ground, and to make it appear that there is some misunderstanding between us about the meaning of words. He pretends that we are not agreed on the proper meaning which should be given to the words "Loss of power," when applied to the mechanical contrivance of a crank. Now, as the concluding part of his letter is altogether confirmatory of my views, it is very necessary, to prevent cavilling about words, to explain, in language which cannot be misunderstood, what my meaning of the term "loss of power" is; and I shall expect equally as explicit an explanation from my opponent.

Let us suppose two steam-engines, one on the rotative principle, but, speaking theoretically, without friction, the other with a crank, also without friction; and let the boilers and daily consumption of coals be perfectly equal; and let the proportions of each engine (again speaking theoretically) be such that the quantity of work done by each with the given boilers shall be a maximum.

Further, let the work required to be done be of the same description in both cases, and involve a considerable degree of fric-

tion,* such as grinding corn, spinning, &c. If the rotative engine, under these circumstances, is found to do more work,—if the larger quantity of work performed by that engine shows that the whole power is not given out by the crank, which it receives from the first mover,—then, I say, there is a loss of power in the crank. I think it unnecessary to answer those who require to know what becomes of the loss; that loss as certainly takes place, whether it be from loss of effect or destruction of power: and this is clearly the meaning of the term "loss of power" made use of by Mr. Russell, Mr. Sang, and many others, whose writings on the subject are to be found in your Magazine. If the case were otherwise, why should these gentlemen contend that a person who would endeavour to contrive a machine for ordinary works, such as grinding corn, &c. &c., without the intervention of a crank, must be ignorant of the first principles of mechanics? When I mentioned the circumstance of drawing a spike out of a piece of timber, the pulleys, screws, levers, wedges, or any other mechanical contrivance to effect that purpose might be assumed to have no friction; but your correspondent cannot dispense with the friction of the spike; one pound might lift the spike, but it might require one ton to draw it! Now your correspondent is disposed to turn round and to cavil with me about this friction, on the ground of a misunderstanding about words, and that this friction was excepted,—that is, the very work required to be done was excepted. How else am I to understand him, when he says, in the latter part of his letter, that the work must be such as will answer for a crank engine? Does he mean that grinding corn is not proper work? He admits, almost in as many words, that such work cannot be well done without a fly,—his crank will not move without momentum. And thus he supports my argument, which is corroborated by the experiment. *The spring in my experiment did not require momentum.*

Your correspondent objects to my experiments because there is no similarity between them and a crank; but I need not remind him, that if the doctrine of virtual velocities applies to the crank, in cases where there is much friction, it must equally apply to my experiments. Moreover, he objects, that in these experiments I jump from an angle of 90 degrees to one of 30 degrees. Now it is surprising to me that he could not perceive that my doing so was a circumstance in his favour, and against myself; for had the leverage of the cross-bar been gradually reduced, as it is in the crank, from 90 to 30, the weights which, to support his views, should have moved over a greater space, would, in that case, have moved over a less space.

I will give another example of my meaning of the term "loss of power," and one which, I presume, will not be found fault with as being of an imaginary character. I allude to the experiments described by your Aberdeen correspondent, published some time back in your Magazine, where the same boiler was made use of, and the same quantity of fuel to work the engine at one time with a crank, and at another time without it. Your correspondent's admission that the crank-engine did not do one-half the work of the other, I call "loss of power." I call that loss of power also (though your correspondent seems to be at a loss to comprehend it) where, in the experiment with the non-momentum apparatus, as well as in the other experiments, 37 lbs. could not be drawn over a space of six inches. "Get a suitable apparatus," says your correspondent, "and it can be done." Very true—or take away the crank, he might have said, and almost any other contrivance would do it. $74 \times 3$ will not answer the conditions, as your correspondent will discover, if he will examine these experiments a little more particularly. Moreover, the space required to be passed over was 6 inches, not 3 inches.

R. W. T. observes, that he might safely undertake, with the addition of another cross-bar (so as to suit it to the work to be performed), to make it re-produce the lost power—(What lost power, if none had been lost?)—and make it move the 36 lbs. six inches. And he thinks I could easily find out how this could be done. There could be no contrivance of the kind placed between the cross-bar and the power, or between the crank and the first mover, in any case, that would have the effect he alludes to, without changing the principle altogether of the action of the crank.

Your correspondent complains that I do not notice his experiment with a model, which he thinks more like a working crank, and affects not to understand what I mean, when speaking of its *limited* effect. It was not its dimensions which I alluded to, but the impossibility of trying the necessary experiments with different descriptions of work with sufficient accuracy, and with the same facility, as in my experiments.

* The word friction, as used in all these papers, is not confined to the rubbing surfaces of the machinery, but embraces every thing connected with the work to be done that retards or opposes motion. The resistance of paddle-wheels is as much an element of friction as the axle friction of the wheels, according to the view taken of it in these papers, and by such *unscientific* authorities as Smeaton.

I will now allude, in a few words, to some other circumstances connected with these experiments. It will be observed that, in these experiments, the crank is represented as moving in one of two quarters of its revolution, and that its motion in that quarter is from a state of the greatest leverage to the dead point; and, consequently, a quarter of its revolution most favourable to the action of the crank. The other two quarters of its revolution, namely, from the dead point in the circle to the point of greatest leverage, would have been one more in my favour, and against the crank; as the destruction of momentum in the first case was applied in performing the work, whereas the restoring the momentum was done at the expense of the power. Moreover, it will be observed, that at the termination of all these experiments, where the cross-bar was made use of to represent the crank, the power would not have been sufficient to move the weight the smallest quantity beyond the assigned distance on the table, even had it been able to reach it, which it was not. But in all the cases where the cross-bar was removed, the power would have been sufficient to carry on the motion beyond these points, if required. Again, it will be seen that the spaces passed over on the table by the weight, are not equal on each side of the line drawn across the table, although the work done on each side was equal; there was, consequently, unequal work done in equal times, but the uniform motion of the fly-wheel must interfere, and cause an approach to what, under the circumstances, would be impossible—equal work to be performed in equal times; and therefore must injuriously interfere with the action of the crank.

I am, Sir, yours, &c.

M——.

PHOTOGRAPHY—AND SOMETHING MORE.

A very remarkable discovery, with respect to the self-transmitting property of figured surfaces, under certain circumstances, has been recently made by Dr. Moser, of Konigsberg, which would seem to indicate that there is something else than *light* concerned in the production of such effects, and that we must look for some fitter term than *Photo*-graphy to designate the branch of science or art to which they belong. The following is the account of this discovery, brought to this country by Professor Bessel, as communicated by him to the late meeting of the British Association, through the medium of Sir David Brewster, and published in the *Athenæum.*

A black plate of horn, or agate, is placed below a polished surface of silver, at the distance of one-twentieth of an inch, and remains there for ten minutes. The surface of the silver receives an impression of the figure, writing, or crest, which may be cut upon the agate or horn. The figures, &c. do not appear on the silver at the expiration of the ten minutes, but are rendered visible by exposing the silver plate to vapour, either of amber, water, mercury, or any other fluid.

Sir D. Brewster stated that he had heard Prof. Bessel say, that the vapours of different fluids were analogous to the different coloured rays of the spectrum; that the different fluids had different effects, corresponding to those of the spectrum; and that they could, in consequence of such correspondence, produce a red, blue, or violet colour. The image of the *camera obscura* might be projected on any surface—glass, silver, or the smooth leather cover of a book—without any previous preparation; and the effects would be the same as those produced on a silver plate covered with iodine.

This paper gave rise to an animated conversation, in the course of which *M. Bessel* said that he had seen some of the pictures taken by this process, which were nearly, but not quite, as good as those obtained by Mr. Talbot's process.—*Sir D. Brewster* said, this was the germ of one of the most extraordinary discoveries of modern days; by it there seemed to be some thermal effect which became fixed in the black substance; and not only so, but M. Bessel informed him, that different lights seemed to affect different vapours variously, so that there seemed to be something like a power of rendering light latent; a circumstance which, if it turned out so, would open up very new and curious conceptions of the physical nature of light; on the emission theory, it would be easy to account for this; on the undulatory theory, he could not conceive how it could be possible. *Prof. M'Cullagh* said, he believed Newton had somewhere thrown out a suggestion, that luminous particles, as they entered into bodies, might be caught and retained, within certain bounds, by continual attractions.—*Sir D. Brewster* said, that the experiments which he had performed with nitrous gas seemed to strengthen some such view as this, for, at certain temperatures, we had here an instance of a gaseous body as impervious to light as a piece of iron.—*Sir J. Herschell* thought it a pity to encumber this new and extensive

field of discovery now laid open to them by any speculations connected with the theory, either of undulations or emissions. He had found that paper could be so prepared, as that the impressions of some colours might become permanent upon it, while others were not; and thus it became possible to impress on it coloured figures by the action of light. He exhibited a piece of paper so prepared, which, at present, had no form or picture impressed on it, but which was so prepared, that, by holding it in strong light, a red picture would become developed upon it. He wished much he could prevail on Sir W. Hamilton to explain to the meeting a metaphysical conception, which he had disclosed to him, and which seemed to him, though darkly, he owned, to shadow forth a possible explanation of many difficulties.—*Sir W. Hamilton* said, that, appealed to by Sir J. Herschel in this manner, he could not avoid placing before the meeting the theory alluded to, however imperfect and obscure. He then explained it; but we regret our inability to express it adequately. It appeared to depend on the conception of points, absolutely fixed in space, and endowed with certain properties and powers of transmission, according to determined laws.—*Professor M'Cullagh* had indulged in speculations allied to, and, as he conceived, involving this very conception of Sir W. Hamilton, and had even followed out some of its consequences, by reducing it to a mathematical form—the conception was of double points, or poles, transmitting powers—but he had abandoned it as a mere speculation.—*Sir D. Brewster* thought these speculations tended to repress experimental research, and to turn men's minds from what was solid to what was fanciful. He conceived, also, that indulgence in them, and mere abstract mathematical research, by rendering men averse from the more humble and laborious pursuits of experiment, absolutely produced a distaste for these subjects; and to this he attributed the fact that, while learned societies frequently overlooked, and even refused to publish in their Transactions experimental papers, the transcendental flights were always sure to find a welcome place.—*Sir J. Herschel* considered that there could be no true philosophy, without a certain degree of boldness in guessing; and such guessing, or hypothesis, was always necessary in the early stages of philosophy, before a theory has become an established certainty; and these bold guesses, in their proper places, he conceived, should be encouraged, and not repressed. Sir W. Hamilton's conception he thought perfectly clear in its metaphysics, and should not be thrown overboard, merely because it was metaphysical. The *President* hoped that Sir W. Hamilton would develope and publish this speculation, in order that it may be sifted, scrutinized, and rejected, if merely ideal; or established and adopted, if solidly founded in nature and fact.

## RECENT AMERICAN PATENTS.

[Selected and abridged from the *Franklin Journal*.]

METHOD OF WETTING FLANNELS AND OTHER CLOTHS PREVIOUS TO SCOURING OR MILLING; *Joseph W. Hale*.—A colander, pierced with numerous small holes, is attached to a reservoir, or tank, of water, by means of a pipe, the orifice of which is regulated by a valve, to which a cord is attached, having a weight at its opposite end, for the purpose of keeping the valve opened when desired. A roller is placed at one end of the frame, and two at the other end, and the cloth, in going from the single roller to the double set, by which it is drawn through regularly, passes under the colander, and receives the spray from it.

IMPROVEMENT IN THE JOINTS OF SPECTACLE FRAMES; *Thomas Eltonhead*.—"It has heretofore been the practice, in forming the frames of spectacles of metal, to divide the end-pieces, which are soldered to the rims containing the glasses, into two parts, and to connect these two parts together by means of a screw. The joint-pin has been affixed to one of these parts, and the side, or temple pieces, have had the tubes through which the joint-pin passes soldered to them.

In my improved construction, I make the end-pieces solid, instead of dividing them into two parts, and into this solid piece I file a notch, to receive the end of the temple piece, which is to be adapted thereto, and a hole drilled through for receiving the joint-pin."

ROTARY STEAM ENGINE; *Isaac N. Whittlesay*. "The general construction of my improved engine," the patentee says, "is similar to that of some others which have been heretofore constructed, but I have made such improvements thereon as are intended and calculated to obviate some of the difficulties which have been experienced in its action. The principal of these improvements consist in the employment of the steam to open and close the sliding valves, and in the arrangement of some of the other parts by which its action is governed."

Within a hollow case, of the usual construction, "revolves a drum, which carries two valves, to be operated by the action of the steam, which action causes the said inner drum, with its shaft, to revolve in the ordinary way. The valves, which are connected together by a rod, slide into recesses made

for them in the drum, which is hollow towards the shaft, for the reception of a disk, attached to one of the heads of the outer drum. This disk is at some distance from the head plate to which it is attached, and the space between them is divided by a partition, so as to divide the induction from the eduction pipes. The steam introduced through the induction pipe passes into the hollow space of the inner drum, acts against the inner end of one of the valves, which is thus forced out, and then passes through a hole by the side of the valve into the steam chamber, and impels the valve and inner drum by its reaction on a stop attached to the inner periphery of the outer drum. The openings which admit the steam into, and allow it to escape from, the drum, must be so regulated as to correspond with the position of the stop. The steam may be made to enter the space between the two drums on either side of the valves by a shifting plate, which opens an aperture on one side as it closes the one on the other side, so that by shifting this plate, the motion of the engine may be reversed.

The claim is confined to the manner of protruding the valves by the elastic force of the steam, acting behind them; and also to the manner of reversing the motion of the engine by shifting the plate.

MACHINE FOR CLEANING AND DRYING FEATHERS; *Nathaniel L. Manning.*—The patentee says: "I claim as my invention the mode herein described of drying and cleansing feathers, by means of carbonic acid gas, hot air, and other products of the combustion of charcoal, or other suitable fuel, introduced among the feathers during the process of whipping and separating them from each other, in the manner described. Second, I claim whipping and separating the feathers from each other, by means of bows and sails applied to a revolving shaft, which shaft shall remain in one position, while revolving, and the feathers be brought under the action of the same, in the box in which said shaft revolves, in any convenient manner, or said shaft may be moved over the mass of feathers, and back and forth throughout the box, by means of a band and pulley, or a chain belt and cogged pinion. Third, I claim closing the elongated slots, or apertures, in the sides of the box, so that none of the feathers may escape, or impede the operations of the machinery, as the revolving shaft is moved to and fro, by means of a band lying over the same, and travelling over drums, or pulleys, and operated by the revolving shaft, as set forth."

We deem it unnecessary to add any explanatory remarks, as the alleged improvements are sufficiently pointed out in the above; we have no doubt that this machine will be equally good with some of the previously patented feather-dressers, which have had their day, and are almost forgotten.

IMPROVEMENTS IN LAMPS FOR BURNING CHEMICAL MIXTURES, OR COMPOSITIONS OF ALCOHOL, SPIRITS OF TURPENTINE, &c.; *Benjamin F. Greenough.*—The claims express the character of the improvements sufficiently to enable any one acquainted with the construction of lamps to understand them. They are as follows:

"Having described my invention, I shall claim—first, the placing of a shoulder on the rod by which the button is supported, said shoulder being so constructed as to set loosely on, and adapting the button to a projection on said shoulder in a similar manner, by means of which combined arrangement the rapid oxidation of the disk, (which is made of platina,) is prevented, as described. Second, guiding the adjusting-rod of the button, by passing the same through a tube, whose lower end is attached to the bottom of the oil-cup, or otherwise similarly arranged, the said tube extending upwards into and through the central part of the interior of the burner, the whole being for the purpose of permitting an uninterrupted current of air to act on the inner surface of the flame. Third, the combination of an adjusting cone, (applied to the exterior tube of the burner by a circular spring, or other contrivance substantially the same, by which its altitude is regulated,) with the adjusting button, or one whose elevation may be varied at pleasure; the whole being arranged substantially in the manner and for the purpose described. Lastly, I claim a cone constructed with an extended cylindrical base, having a series of radial holes through the circumference of the same, and made so as to be adjusted in height on the exterior tube of the burner by means of a circular shelf and spring, in combination with a moveable button, whose rod is supported and guided by a tube connected with the oil-cup, and whose elevation can be regulated by a screw, or other suitable contrivance, the whole being construrted and arranged for the purpose and in the manner described."

A NEW MODE OF PRODUCING A BLACK COLOUR IN DYEING. *John D. Prince.*—The common mordant used in dyeing various articles of a black colour is, as is well known, an acetate of iron; and the best effect of this mordant is obtained when, by the action of the air, a mixture, or compound, of the protoxide of iron is formed on the substance to be dyed. "I have ascertained," says the patentee, "by repeated trials, that the proto-sulphate of iron (cop-

peras) may be advantageously substituted for the acetate of iron, as a mordant, by bringing it into that state which shall coerce it to deposit these two ingredients, the protoxide and peroxide of iron, on the goods under treatment. There are various articles which effect this purpose to a certain extent, but that which I found to do so in the most perfect manner, is the arsenious acid (arsenic) mixed, or combined, with the proto-sulphate. The proportions of the two ingredients admit of considerable latitude, but the following has been found to answer well. I dissolve one pound of copper in a gallon of water, and in another gallon of water I dissolve four ounces of white arsenic, and then mix the two solutions, which mixture constitutes my iron liquor. For the purpose of transportation it is desirable to obtain the ingredients from which the solution is to be made, in a dry state; for this purpose I take copperas, and drive off its water of crystallization by exposing it to heat upon iron, or in any other convenient mode, and to the dried mass I add four ounces of white arsenic for every pound of copperas first taken; the whole is then reduced to powder, and may be readily converted into iron liquor by adding the proper quantity of water. The tendency of the protoxide, in copperas, is to pass too rapidly and completely into the state of peroxide, by which the object of obtaining a good black colour is defeated, an injurious brown tint being produced. The arsenious acid has the property of preventing the peroxidation, and of inducing that state of mixed oxide upon which the perfection of the black is dependant; and this combination of arsenious acid, and its application to the purpose of producing a black colour are, as I believe, entirely new."

## INFRINGEMENT OF PATENT RIGHT.

*Before the Vice Chancellor of England.*

July 30, 1842.

*Rodgers* v. *Stocker and others.*

The plaintiff, Mr. John Henry Rodgers, of Birmingham, obtained letters patent, May 13, 1839, for "certain improvements in clasps or fastenings, principally applicable to certain articles of dress," which he alleges have been pirated by the defendants. Having obtained the usual injunction *ex parte*, the case now came before the Court on a motion by the defendants to dissolve the injunction. It appeared that the defendants had a licence to manufacture hooks and eyes, from Messrs. Barnett and Armfield, who were possessed of a patent granted July 10, 1840, subsequently to the date of the plaintiff's patent. The plaintiff offered to bring an action at law, but contended that in the mean time the injunction ought to stand.—The Vice-Chancellor was of opinion that the articles made by the defendants were a clear infringement of the plaintiff's patent, and refused to dissolve the injunction.

## PIRACY OF DESIGNS.

*Guildhall, London.*

August 6.

Mr. Johnson, of Bow-lane, agent to Messrs. Pratt and Son, carpet manufacturers, Barnardcastle, attended before Mr. Alderman T. Wood and Mr. Alderman Farebrother, to answer a complaint lodged against him for selling a carpet whereon had been used a part of a design which had been registered as copyright, knowing that the proprietor thereof had not consented to such use of his design. Mr. Jones, a solicitor, attended on behalf of the defendant.

Mr. Clarkson opened the case on the part of the complainant, Messrs. Kipling, of Darlington, carpet manufacturers. The complaint was laid under the 2d Victoria, c. 17, to secure to proprietors of designs for articles of manufacture the copyright of such designs for a limited time. The first clause gives the proprietor a right to the sole use of his design for one year from the day of registration. Then the proprietor is entitled to sell and convey his right to another person, and a penalty not exceeding 30*l.* is attached to pirating a registered design, or selling any article whereon the whole or any original part of a design has been copied. The proprietor of a registered design is bound to affix to every article sold a notice that he is the owner thereof, with number and date of registration. The seventh clause is a very sweeping one, declaring that the production of the registrar's certificate shall be evidence, in the absence of proof to the contrary, of the design being duly registered, of the proprietor thereof, of its originality, and the commencement of the period of registry. Mr. Rothery, the town agent of Messrs. Kipling, would give evidence that their design had been copied pretty closely as to the appearance of the whole pattern, though, in fact, there was a deviation by extending a little a scroll in the border, and in two other places altering a flower into a square. Mr. Clarkson exhibited two lengths—one the registered pattern, the other the defendant's imitation. He observed that the peculiar fabric, a sort of Venetian, as to the mode of weaving the cloth, while it had the richness of colour and style of the Brussels, was also copied, so that seeing the two apart the public generally would take one for the other.

Alderman Wood observed that it would be convenient to the magistrates to understand clearly the case and the nature of the answer to it, before they went into evidence, as it was the first case of the kind. There was no appeal, and if it were desirable that the matter should go before a superior court, it would be better that the magistrates should refuse to hear the evidence, and then the question could be raised before the judges by moving for a *mandamus* to compel the justices to hear the charge. He and Mr. Alderman Farebrother would feel great reluctance in deciding, as there was no appeal, unless they saw their way clearly. Was Mr. Clarkson calling upon them to decide what amount of variation might be allowed?

It was then explained by Mr. Jones that their answer was that the design was not original, and was not protected by the registration. It was made up of parts which had long been known, and by re-

gistering a few of these combinations, including all the forms usually worked in carpets, Messrs. Kipling could prevent other manufacturers from using them, or any part of them, they would monopolize the supply and stop the whole trade.

Mr. Clarkson said, his complaint was that an original part of the design had been pirated. He did not contend that no part of the pattern might be used, but that his new combination of a number of parts should not be imitated, Messrs. Kipling paying workmen to produce such new combinations. He then called his evidence.

Mr. Rothery, of Addle-street, agent to the complainants, produced the certificate of registry on the 15th of March, 1842. The carpetting was always labelled as copyright when sold. The defendant's was a close imitation, even as to the form of weaving, as well as the colours and pattern. In June he had a conversation with the defendant, who stated that he had paid 5s. to search the registry, doubting whether the pattern had been registered as original.

Mr. Alderman Wood observed, that it was the combination that was alleged to be the original, just as in music the minute parts or single notes were not new, but a new combination might be made which entitled the inventor to the protection of copyright for his talent.

Mr. Alderman Farebrother asked if the defendant could show that he made carpets of this pattern before the complainant registered?

The defendant said no; but produced some patterns of oil-cloth and carpet, to show that minute portions had been used before separately.

William Hare proved the purchase of a piece of carpet from defendant. He told him it was Kipling's pattern, and defendant replied it was not original, and he should sell it in spite of any one.

Mr. Alderman Farebrother asked if the price was the same?

Mr. Hare replied no; defendant sold at 1d. under.

Defendant examined Mr. Graham, of Bridport-place, Hoxton, a draughtsman, to show that the whole pattern was new. He called it new, but not original.

Defendant, finding the opinion of the magistrates was against him, then objected to their jurisdiction, he residing in Middlesex, though he had a warehouse in London. The statute requires the complaint to be made in the district where the offender resides. He made this objection that he might be prepared with counsel to meet Mr. Clarkson if the question should be raised again.

Mr. Clarkson characterised this as a miserable objection, unworthy of a respectable tradesman.

The magistrates determined to take time to consider whether they had jurisdiction, and adjourned the hearing. They were both of opinion the offence was proved.

## NOTES AND NOTICES.

*The Melophonic Guitar*, is the very appropriate name of a new instrument which was introduced to the musical public, a few days ago, by the inventor, M. Barelli, at a Soireé musicale given at the Hanover Square Rooms, purposely to ascertain the effect it would produce upon a numerous audience. Sig. Regondi the well-known and accomplished guitarist performed on it four times with extraordinary applause. The audience (about 700 persons, the large Concert room being full,) accustomed to the insignificant-sound of the common Guitar were taken by surprise and delighted by the sweet and full-bodied tones of this new instrument. Of its speedily superseding the old guitar there can be no doubt; or as we should rather say, perhaps, there can be no doubt of its occupying the place, once held by that instrument in popular esteem, for so much has it gone out of fashion that the town of Mirecourt in France, the chief seat of the guitar manufacture, and which used to export annually about 20,000 instruments, has at present only two or three hands employed in it. M. Barelli, the inventor of the Melophonic, is about to establish a manufactory in London, and we should not wonder if this become ere long, instead of France, the guitar exporting country.

*The Royal Steam Navy.*—In addition to the *Penelope*, of 650 horses power, and *Dragon*, of 800, already in course of construction, the Admiralty have ordered Mr. Oliver Lang, the master shipwright of Woolwich Dock-yard, to submit to them a plan for a third vessel, of 1,650 tons, and 800 horse power.

*The Earl of Rosse's Large Telescope.*—Sir James South states, in a letter to the *Times*, that he has received from the Earl of Rosse the gratifying intelligence, that, on Saturday the 30th ult., the speculum for his leviathan telescope was safely removed from the annealing oven, where it had lain for the long period of nearly sixteen weeks.

*Mr. Clement's Nautical Inventions.*—The Lords of the Admiralty have liberally placed the *Black Eagle* steamer at the disposal of M. Clement, of Rochfort, for a couple of weeks, in order that he may test the value of the different nautical inventions which he has recently patented in this country, and of which we gave an account in our 989th Number.

*March of Improvement in Portugal.*—Senhor Barreto was announced, some time since, to have obtained a contract for lighting the streets of Lisbon with the new and brilliant substitute for gas, composed of seven parts of spirit of wine and one of turpentine, which unquestionably would produce a most splendid light, and which, from the local cheapness of wine, could be furnished at a comparatively moderate rate. The project, however, seems to have been since consigned to "the tomb of all the Capulets," contemplated improvements here bearing a uniform resemblance to a bottle of low-priced ginger beer. When the light is first let in upon them, there is a deal of effervescence, and a monstrous phiz: but the spirit is all instantaneously evaporated, leaving only a dirty sediment behind. A great fuss was likewise made about the intention to macadamize the principal streets. The pavement has in two or three cases been ripped up, and the macadamizing process has been applied to the centre of the street, the sides being carefully reset with pavement! Macadam's principle is thus introduced in the central parts, to be trod only by oxen and gallegos, while the accursed old pavement is still to be inflicted on more civilized pedestrians. Verily, it were well to have a little less factious mouthing in the Cortes, and a little more progress amongst Peninsular progresistas. Talking of progress, I am happy to note any thing in its shape. I have therefore pleasure in commemorating, that the Minister of Marine has established *paper* mails between Lisbon and the several Portuguese colonies. These mails are to run both ways every two months; seeing, however, that *paper* mails are no new contrivance here, but were established by portarias of the 17th of March, 1835, and 7th of September, 1838, to Cape Verd, St. Thomas's, and Angola, and that by portaria of the 22nd of November, 1839, the said mails, which were before said to be quarterly, were directed to start thenceforth every two months; and seeing, furthermore, that nothing of the kind took place in fact, I must wait for proof of this new Peninsular progress.—*Correspondent of the Times.*



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# Mechanics' Magazine,

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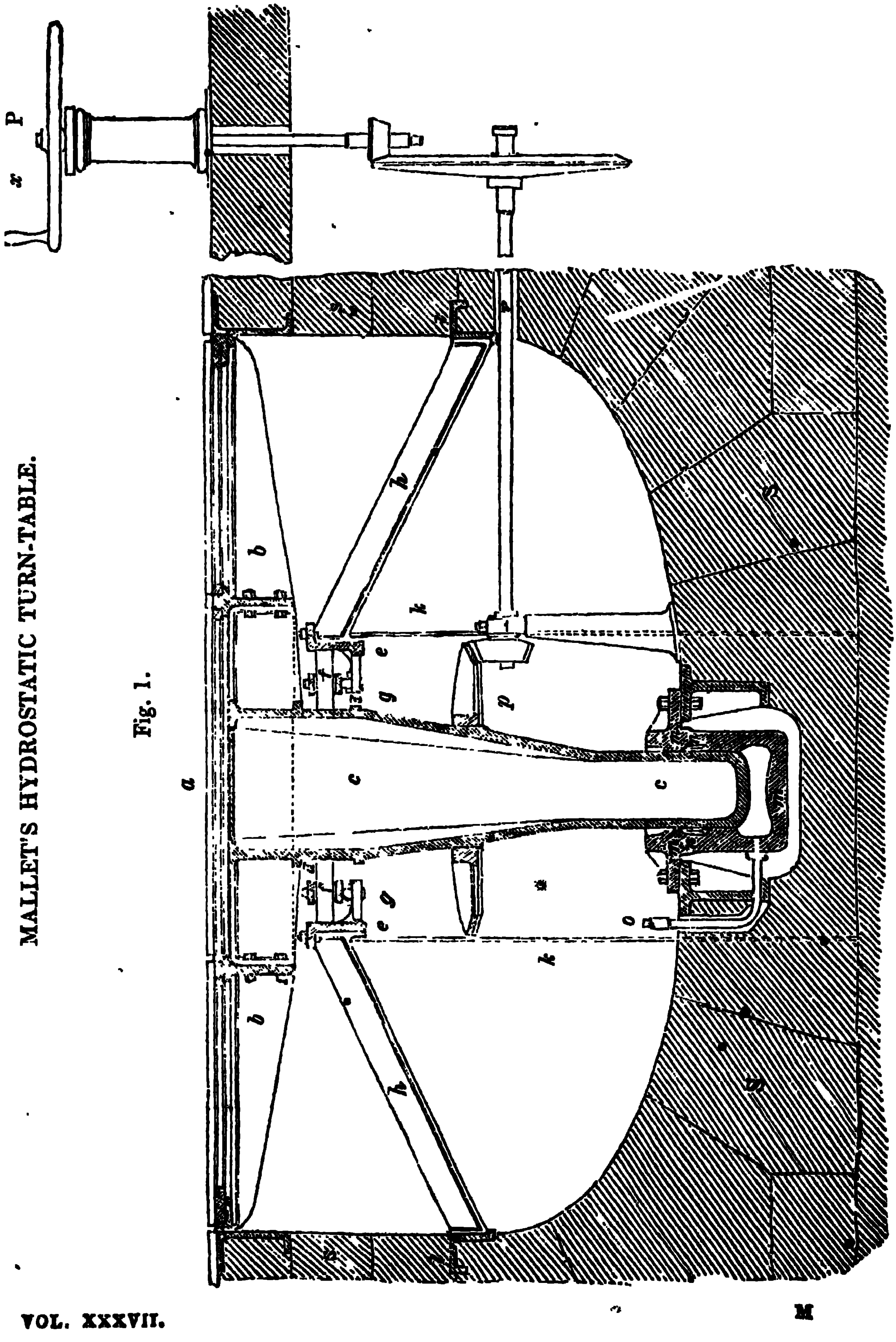


Fig. 1.

MALLET'S HYDROSTATIC TURN-TABLE.

## ON A NEW ARRANGEMENT OF PARTS FOR RAILWAY TURN-TABLES. BY ROBERT MALLET, ESQ., MEMBER INSTITUTION C. E.

The disadvantages found to exist in turn-tables as at present usually constructed, arise chiefly from the pressures which are altogether vertical, sooner or later forcing the bearing rings out of level, by which a portion of the whole weight has to be lifted to produce a revolution; from the bending of the top and bottom bearing rings, by which distortion of the other parts is produced at each change of position of the load; from friction upon the bearings, rollers and their axles, and upon the centre pivot, which becomes enormous by the results of the preceding defects. Where sufficient strength of parts is provided in the first instance and means of posterior adjustment also, turn-tables may be constructed upon the ordinary plan—by which I mean that in use, as for instance, upon the London and Birmingham, and Great Western Railways—which, with a very heavy load shall be capable of easy motion. Thus, some constructed by the works with which I am connected, for the Dublin and Kingstown Railway of 14 feet diameter, could with perfect ease be turned rapidly by one man, with a load of about twelve tons. To obtain this perfection, however, heavy castings and an expensive foundation become indispensable. At a more recent period it seemed to me desirable, if possible, to produce a modified construction of turntable, such that all the parts should admit of ready adjustment—that the friction should be a minimum—that the strains should be diffused upon the foundation and masonry generally beneath the table—that all its parts should be easy of access, for adjustment and repair—and that motion should be communicated to the table if desirable, by means of gearing actuated by a man stationed at a distance from the engine, or table.

These objects I consider in some degree fulfilled by the construction of turntables, of which I transmit the accompanying vertical section, fig. 1, and which, from the principle of vertical support introduced, I have named "The Hydrostatic Turn-Table."

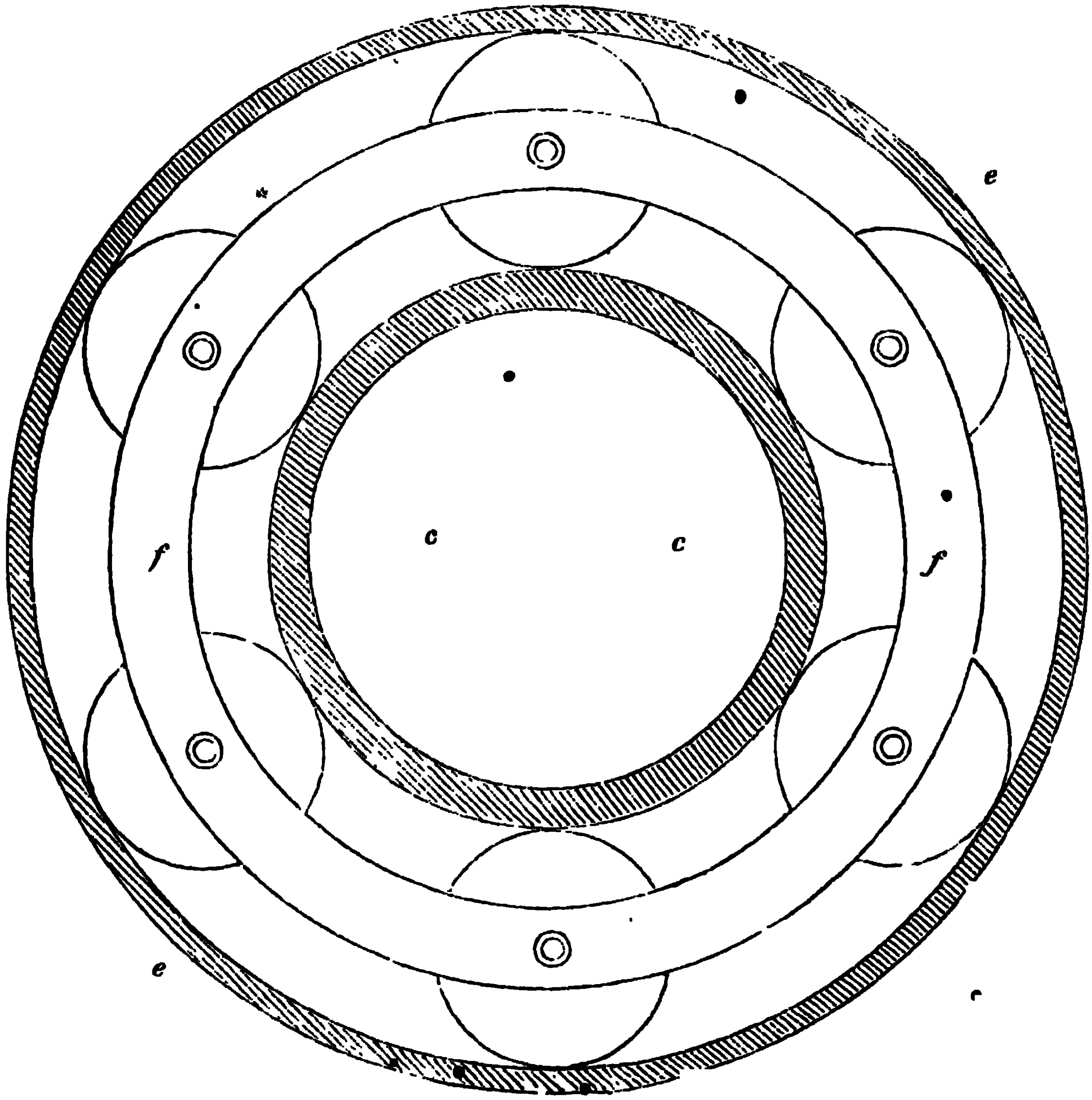
The platform of this table is much the same as usual, consisting of four or more interlacing ribs of about 12 inches in depth, at the centre, connected by a ring at the circumference, and all cast in one piece. The tops of the ribs carry the crossing rails, and the interspaces are planked, or open cast iron trellis gratings are dropped into them and rest upon a rabbate. The central portion of the ribs are secured by bolts, to the projecting flanches of the large vertical pillar or pivot, upon, and with which, the whole revolves. The length of this pivot is about equal to half the diameter of the table; its lower portion, as well as a broad collar, or neck, close under the platform, are turned truly cylindrical, while the form of the remainder is generally conical.

This central pillar, or pivot, is cast hollow, and for a turn-table of 12 feet diameter, and for heavy engines, should be about 2 feet diameter at the neck, and about 10 to 12 feet diameter at the lower end, and of thickness suitable for sufficient strength. At the same level, and concentric with the turned collar of this pivot, is placed a cast-iron bored ring, considerably larger in internal diameter than the external diameter of the pivot, and which is sustained in its place, and all lateral, or other motion thereof prevented by a number of diagonal struts, (usually twelve,) and by four vertical bolts fitted and bolted to the outside of the ring, or as I shall call it the bearing collar, and also to a large concentric ring casting, which is built into the side walls of the turn-table pit, and is so formed in section, that when bedded into the stone course on which it rests, and the next course laid thereupon, it binds together the whole of this part of the masonry as into one mass.

The lower part of the main pivot consists of a turned cylinder, like the plunger, or ram of an hydraulic press, and which, also, like the latter, drops into a strong bored cylinder of a few inches in length, prepared at its upper lip to receive a double leather collar, upon Bramah's plan, so as to remain watertight under considerable pressure; the cylinder has a close bottom, and is provided with a small tube opening into one side, and closed by a screw-plug valve of simple construction, by which the interior of the cylinder may be filled with water. The lower part of the turn-table pit, con-

sists of an inverted arch, or rather dome, of brick or stone, resting upon a bed of concrete when requisite, and this small hydraulic cylinder is bedded down upon a cast-iron ring, forming the centre or crown of the inverted dome, and is secured and adjusted to the latter, by means of bolts passing through a projecting flanch cast round it. The platform of the turn-table being supposed level, and in its berth, it is obvious that this main pivot, is, in fact, a vertical axis or shaft, along with which it can revolve. It is plain that any weight upon the platform,

Fig. 2.




whose centre of gravity is over this axis, will only produce a downward pressure upon the lower end of the pivot; but that if the centre of gravity be to one side, as at the moment when an engine is passing on to the table, a horizontal, or nearly horizontal force will act upon the pivot, tending to produce lateral motion in it round its lower point as a centre, or to break it transversely. To counteract this latter force is the object of the upper collar and bearing collar; between these, into the annular space, left by reason of their different diameters, is dropped a circular wrought-iron frame, consisting of two rings of flat bar iron, carrying six turned

cast-iron rollers, revolving horizontally between these collars, upon wrought-iron pins which pass through and connect both wrought-iron rings. The weight of these rollers and rings is sustained by four small rollers, which are fixed as to position, and revolve vertically in pairs, cast in brackets, projecting inwardly from the turned bearing collar.

Now, if the platform be adjusted level, the pivot therefore vertical, the roller frame in its place, and the rollers themselves nicely filling the interval between the collars, and the hollow cylinder below filled with water, beneath the toe of the pivot or plug, it is obvious that the system will be in a condition to sustain a load, however disposed upon the platform, and that the latter can revolve with it, the only resistances being, the direct and secondary, or rolling friction of the collars and roller frame above, and the friction of the leather gland and fluid support below. The lateral force, if any, is sustained by the rollers and gland; the vertical is supported by the fluid in the cylinder.

The resistance due to friction of the latter, or vertical support, is so small, that we have no experimental data to estimate it by; it may practically be considered as nothing; the resistance will therefore be the friction of the rollers, and of the gland, and this will be much less than in the ordinary table or vertical rollers; for, if the height of the pivot, or distance between the bearing collar, and lower gland, be equal to the radius of the table, it may be easily shown that the strain, either upon the collar or gland, can never equal the whole weight of the body, *i. e.*, of the engine coming in upon the table; while, in the ordinary table, the pressure on the rollers is always equal to the whole weight, but the friction of the rollers is in proportion to the pressure, and hence, is under the most disadvantageous circumstances in favour of the new table; while, when the engine is fairly in upon the table, and in a condition to let it revolve, it is nearly balanced, and hence, *when in motion, nearly all friction, by its pressure, is removed from the rollers—and also from the gland below.* But further, supposing the force to produce rotation, applied in each case at the circumference of the table, the resistance due to friction of the rollers will be in proportion to the radius of the roller frames, or distances from the common centre of motion, with equal pressures; but in the new table, the roller frame has only about one-third the diameter of the table, whereas, in the ordinary case, the roller frame is nearly equal to its full diameter.

Thus, force is economized, not only by *having a smaller resistance to move, but this resistance to move through a smaller space*; and thus it becomes easy, by the application of the bevel gear, shown upon the section as applied to the vertical pivot, &c., to transfer motion to the table by shafting from a distance, by the power of a single man acting upon a small hand wheel and vertical shaft, in the same way that the points, or switches, are usually turned on railway lines. The power of doing so would often be found advantageous, as economizing labour and time, and in crowded or important stations would have the further advantage that all the turn-tables might be attended to, and worked by one man, and at one spot.

The masonry of this form of table is not more costly than that of the ordinary one, nor would the weight of castings, or the amount of workmanship, be greater. There are only two points requiring adjustment from the effects of use, viz., the outer bearing collar, which is made adjustible by keys and bolts, between the diagonal struts, or may be made adjustible in other ways, and the lower gland, the adjustment of which has been already described. From the nearly absolute stanchness which Bramah's leather collar ensures, as seen in every hydraulic press under pressure ten or twenty times greater than here required, there is no reason to apprehend escape of water from the lower or sustaining cylinder; but should such ever be the case, it is capable of being replenished with ease by means of a small hand pump, temporarily applied to the small tube, with the screw-plug valve before alluded to; and this also gives the power of adjusting the table as to level, both at first, and subsequently, if required.

Fig. 2 gives on an enlarged scale a plan of the roller frame and six rollers. The lowermost flat wrought iron ring is quite fair and flush on the under side, the roller pins being countersunk, to allow the whole to traverse freely upon its four small supporting rollers, before alluded to.

In proposing this modification of turntable, I would observe, that its merits, if any, consist only in choice and adaptation of parts; the collar of rollers has been long used for heavy cranes, as in those made by us for the Limerick docks, and the fluid pivot was invented and applied by Mr. Bramah to his planing machine, still in use in Woolwich Dockyard for shaping gun carriages, &c.

ROBERT MALLET,
Member Institution C. E.

Dublin, August 4, 1842.

*Description of the Engravings.*

Fig. 1, *a* surface of table; *b b*, the ribs of frame; *c*, the hollow conical pivot; *d*, the collar; *e*, the outer, or bearing collar; *f*, the roller frame and rollers; *g*, the small supporting rollers; *h*, the struts; *k*, the vertical holding-down bolts; *l*, the strut ring; *m*, the water cylinder, or fluid pivot; *n*, the leather gland; *o*, the supply pipe; P *p*, the moving gear; S S, the masonry.

Fig. 2, *c c*, the hollow conical pivot; *e e*, the outer or bearing collar; *f f*, the roller frame and rollers.

## ON THE CONSTRUCTION OF FURNACES AND BOILERS. BY C. W. WILLIAMS, ESQ.

[Continued from page 136.]

In my last communication I referred to the two main causes for the little advance that had been made in obtaining some fixed and satisfactory data as to the principles, scientifically considered, which should govern us—first, in the construction of furnaces with the view of obtaining the greatest quantity of heat by the most perfect combustion of the fuel employed—and, secondly, in the mode of testing the relative efficiency of such furnaces, and the degree in which they were aiding in producing such perfect combustion. As to the first—the construction of furnaces—those who have written on the subject, (and Tredgold in particular,) have confined themselves to the giving empirical rules, which have no better foundation than some supposed relation between the dimensions of their several parts, but which relation could be traced no farther, or more satisfactorily explained, than by reference to some inaccurate and often discordant experiments. The inferences drawn from such were therefore, necessarily, as vague and various as the circumstances under which they were made.

What was thus done with respect to *furnaces*, and the rules laid down for their construction, also took place in what regarded boilers. The rules for the latter, made without a knowledge of, or even reference to, the chemical process of vaporization, or the natural laws which govern the conduction and transmission of heat through metallic or liquid bodies, were, like the former, based on some imaginary or assumed relation of proportions among the several and respective surfaces and areas, *mechanically* considered.

In both cases, too, this doctrine, or implied harmony of parts, being deduced from what was called "practice," became thus clothed with the supposed character of certainty, or matter of fact, and thence was received as infallible, in contra-distinction to the dictates of science, which were rejected as being merely speculative or theoretic.

Yet this furnace and boiler practice—this very thing which demanded improvement and regulation—was in fact nothing more than the rudest and most slovenly operations, conducted without reference to chemical principles, and often in direct opposition to the best established chemical truths. Nevertheless, the results and inferences drawn from such have been, by several writers, worked up into rules, and issued with all the authority of established practice.

With respect to the second point above referred to—the mode of testing the principles on which furnaces may be constructed, and the degree in which such construction may be found to aid or obstruct the natural process of combustion—I stated, that the only test hitherto applied was, strange to say, not anything connected with such furnace, or the processes to be carried on in it—with the quantity of heat generated, or temperature of the products from the fuel—but a test drawn from a totally different process, conducted in a totally different class of vessels, namely, the process of evaporation, carried on in an iron boiler. This boiler, be it also remembered, with all its good or bad evaporative powers and peculiarities, was itself as little understood, and is to this hour as much the

subject of examination and improvement, as the furnaces themselves, of the relative value, efficiency, and economy of which, however, it was assumed to be a certain and safe test and standard.

Referring this latter branch of the subject to a future communication, I will on the present occasion confine myself to the examination of the first of these sources of error and confusion, that is to say, to the "rules" laid down for the construction of furnaces and boilers, and the dangerous, though prevalent mistake of basing such rules on mechanical and mathematical, rather than on chemical considerations and principles.

It may here be asked, *in limine*, what connexion or necessary relation there is between mere mechanical proportions, as regards furnaces, and the processes to be carried on in them, so as to authorize our considering their construction as dependant on the former, rather than the latter? Yet we have abundant references to such details, and to the necessity for accuracy in such relative proportions, but none which examine or explain the really desirable object, namely, their connexion, chemically, with those processes. And are not combustion and evaporization two processes peculiarly referable to chemical, rather than mechanical considerations? Would it not be a more rational proceeding to construct the vessels, in which these distinct processes are to be conducted, with reference to their uses rather than their forms?

Where shall we find, in the whole range of authorities, any chemical investigations or manipulations decided by reference alone to the sizes, surfaces, or cubical contents of the retort or other apparatus to be employed, rather than to the nature of the ingredients employed—their solid, liquid, or gaseous characters—and the conditions under which their union or action are to be effected? Yet combustion, is essentially and exclusively chemical action and chemical combination.

Indeed, we find none hardy enough to dictate or recommend such an absurd proceeding in the laboratory; but the moment the same operations and processes are to be carried on in the manufactory, and on the large scale, the reasonings and inductions of science are to be at once discarded; then, every tyro or ignoramus, down to the common stoker, is supposed to be a safer guide, and have a sounder opinion, than those who go into the inquiry with caution, and respect for chemical authorities and truths; and, by examining the laws and conditions of nature, as regards the fuel or other materials to be employed, are enabled to judge how far the sizes, proportions, and details of the furnaces or other vessels bear on such laws, and can be made instrumental in their development.

And what is the operation, in respect to which the furnace is to be constructed, but an extremely complex chemical one, namely, combustion, or the chemical union of a combustible with the "supporter," or means of combustion, the oxygen of the air; and the involved considerations under which such union is to be effected?

Again, what is the operation, and the object sought, as regards the boiler, but the conduction or transmission of the largest quantity of heat, in obedience to those natural and chemical laws which govern such transmission, (itself a most difficult branch of science,) and the absorption of such heat by the liquid? And are all these involved and complex laws and processes to be set at nought, and the whole resolved by reference to mechanical proportions alone? Is it rational or safe to follow the suggestions of men, (though calling themselves "practical," as every mere fireman or bricklayer does,) who are manifestly unacquainted with those processes, and the various and complicated conditions under which they are effected, in determining on the character or construction of the apparatus employed, or the mode in which the manipulations are to be conducted? Are we to reject the science of Leslie, and Davy, and Dalton, when investigating the laws which govern the transmission of heat, the cause and character of combustion and flame, and the quantities and laws of the diffusion of the gases, the very *sine qua non* of perfection in the operations of the furnace? Are we to consider these great men as having written and laboured in vain, or their authority as dangerous, and to be set aside, to give place to the "instinct of ignorance" of the "fireman and operative engineer," as we are gravely and offensively recommended to do in Mr. Armstrong's Essay on Boilers?

But, further, it is not merely the chemical processes of combustion in the furnace, and vaporization in the boiler, and the difficult, though all-important branch of the subject which the venerated Dalton has investigated, that are to yield to this scale of proportions, mechanically and mathematically considered. No; even their joint relation to the power of the steam-engine itself is to be determined, to a fractional part, by this doctrine of proportions. Now, although this "instinct of ignorance" has had its sway and influence long enough, the absence of any determined scale of relative proportions between the furnace, the boiler, and the steam-engine power is as notorious as ever, and the practical world still calling out for information; and this, although Mr. Armstrong himself, with an admirable contempt of common sense and chemistry, informs us that the whole is an extremely simple and well-defined mathematical process, and that all we have to do is to make the number of horses' power, a geometrical mean between certain defined proportions of fire-grate and certain other defined proportions of boiler surface. Well may it be said, that

> "By line and rule
> Works many a fool."

But the utter discordance which prevails among mechanical engineers, even of the highest standing, (of which I will herafter give some illustrations,) notwithstanding all are still active and anxious in search after improvement and perfection: this absence of all system or accordance should long since have shaken public confidence in these dicta and "rules," which, however, have no better foundation than the kind of practice here referred to. "The best way," says the Essay on Boilers, "is to make the area of the fire-grate such, that the number of horses power of the boiler may be a *geometrical mean* between that area, expressed in square feet, and the area of the effective heating surface expressed in square yards. This proportion gives a convenient rule for ready application in practice." Can we, after this, wonder at the want of connexion between "practice" and chemistry in what regards the furnace and its chemical condition and processes? This "best way" is indeed a summary *squaring* of difficulties: for here we have the chemical process of combustion—the conductive power of the metals—the evaporative action of fluids, and the dynamics of the steam-engine, all resolved, harmonized, and dove-tailed, as it were, in the most approved method; and, ***secundum artem,*** brought into the smallest possible compass—suited to the meanest capacity—peculiarly adapted to the "instinct of ignorance"—condensed into a very nutshell. So compact, indeed, that, as we are in the same page informed, these formulæ express all "the relations of those quantities, sufficiently convenient to be inscribed in a corner of a two-foot rule!" How edifying, yet how concise! Can we, after this display, be surprised at the little advance that has been made since the days of Watt, while such pretenders and book-makers are suffered to be our guides, and such absurdities are palmed on the public under the false colouring of practical accuracy and mathematical truth?

But the error of considering the construction of furnaces and boilers, as resolvable by reference to mechanics and mathematics, rather than to chemistry, must further be pointed out before we can see our way to a remedy, and avoid the labyrinth of difficulties into which this so called "practice" leads us. Many instructive proofs of this erroneous practice may be found in Tredgold and Armstrong. I will here refer to one furnished by the latter writer, in which he draws his inferences, and takes as the basis of some notable calculations and formulæ, some loose experiments made with a "common furnace pot, or boiler of cast iron, such as are usually set in kitchens."

Of this boiler pot and furnace, with their respective functions and results, it is worth speaking, seeing that they are taken as representing the "unit standard of steam-boiler power," and the standard by which the manufacturing world are to solve all questions of comparative combustion and evaporation. The proportions of this "boiler pot" and its cubical contents—its heating surface—area of furnace—extent of draught and weight of fuel used, are given with admirable precision. These details should be given in the author's own words since they are to become the foundation of "rules" by which to determine practically, 1st, All that belongs to the heating powers of the

coal: 2, the chemical equivalent of air required: 3, the relative size and proportions of the furnace: 4, the proper dimensions of boilers: 5, the required extent of heating surface: 6, the relative evaporative results of the foregoing: and 7, and above all, the mechanical, mathematical, and even geometrical connexion between all these and the horse power of the steam! For as to any *chemical* connexion which might be supposed to exist between such details, quantities, and results, they are unimportant, and beneath his notice: they are the mere "trammels" which science would interpose to "set bounds to practical results."

"This furnace pot" with which he experimented, "was capable of holding eighteen or twenty gallons," (*plus ou moins.*) "The fire grate was six inches by eight, or one-third of a square foot in area; and the whole of the heating surface exposed was about three square feet. Into this boiler was measured two cubic feet of water, and after having caused it to boil, it was then found" (doubtless after much labour and calculation) "that by feeding the furnace with coal, and the boiler with water, and at the same time managing the draught of the chimney so as to keep the water boiling nearly at a uniform rate, the consumption of good coal was at the rate of four and a half pounds per hour; and the quantity of water boiled away, in that time, was *exactly* two gallons, or very nearly one-third of a cubic foot." Admirable and accurate manipulation! The whole of these very elaborate details dubbed "practical," are so scientifically determined, and withal, so very conclusive, that it is not to be wondered at, that the comprehensive mind which could embrace the whole of this complicated boiler-pot process, should also be satisfied with its claim to become the "unit measure of steam power"—the standard for all future calculations, and on which might safely be raised a superstructure to which the mechanical, practical, and scientific world might hereafter look with satisfaction and advantage.

But let us see how beautifully and ingeniously these details are worked up into a regular formula for the guidance of engineers.

"Now, as it is usual to reckon," says the author, "that the evaporative power of one cubic foot of water per hour is sufficient to furnish steam for one horse power, we have *only* to multiply each of the foregoing results by three, to obtain the following proportions, viz.:—one cubic foot of water evaporated per hour requires one square yard, or nine square feet, of heating surface, one square foot of fire-grate, and 13½lbs. of good coal." How simple and scientific! Let the reader only consider that this formally arranged tissue is seriously laid down and published as the datum line, to which all calculations are to be referred, and which is to settle all disputed relations between combustion of fuel, evaporation of water, and powers of steam. The applicability of this arithmetical equation and scale of proportions to the complicated chemical and dynamical details of furnaces, boilers, and steam-engines, appears to the writer so important that he dwells on it with peculiar satisfaction as furnishing the "unit measure"—the great desideratum—the "be-all and end-all" of the *questio vexata*, combustion with all that belongs to conduction, evaporation, steam power, and even "smoke burning." Can we be surprised, while such details as these pass current, how easily men are led astray, and so called "practical" rules obtain sanction among the unsuspecting class of "operative engineers."

With respect to the doctrine of relative proportions, the results, as shown in the tables inserted in your present volume, page 134, prove its utter fallacy, both as regards the areas of furnaces and the heating surface of boilers. To this, however, I will, with your permission, return. I am, yours, &c.

C. W. WILLIAMS.

Liverpool, August 6th, 1842.

PROGRESS OF FOREIGN SCIENCE.

## Railway Accidents.

The frightful accident of the 8th of May last, upon the Paris and Versailles Railway, has left an impression so durable upon the minds of all, and has been followed by so many discussions, memoirs, and propositions, of one sort or another, both in France and amongst ourselves, that it seems desirable to collect and arrange for future reference, the reports published in foreign journals, of the opinions and discussions of continental

engineers upon the causes, &c. which led to this catastrophe, and generally upon those tending to railway accidents, and the means of avoiding them.

We shall thus be better enabled to judge of the value of the several plans or opinions enunciated, and this seems the more desirable now, as a committee of the mechanical section of the British Association was appointed at its late meeting, to experiment and enquire into the supposed changes in the strength of axles upon railways, produced by their constant use—a change supposed by some to take place, and to be of sufficient importance to account for the fracture of axles in use, and consequent accident.

The accident took place on the 8th of May, and on the next day, M. Cordier read to the Academy of Sciences of Paris a note by M. Combes, engineer of mines, and officially engaged as superintending government engineer of the steam engines existing in the department of the Seine.

This note,—which may be considered as the official communication of the accident to the Academy—gives its details, which having been already published in various places, it is needless here to repeat.

The foremost axle of the locomotive which broke is stated by M. Combes to have fallen between the rails, and hence broke off short at both ends—*the fracture of the iron was lamillar in large plates.*

The driving axle, also, of the four-wheeled locomotive was found broken, and the fracture appeared to have been produced by torsion. The tender of this engine was upset and broken. The six-wheel engine of Messrs. Sharp and Roberts, which came after the first or four-wheel one, was also upset, the axles bent and detached, but not broken: neither boiler was burst. The tender of the second engine was also broken. The five carriages next the engine were thrown of a heap, and the hot coke thrown out of the fire-box of the large engine, fired first the jacketing of the boilers and the engines themselves, and immediately after the carriages, which burned with such extreme rapidity, that they were consumed in about ten minutes.

M. Combes concludes by saying, "without entering into a discussion of the causes of the accident, it must be obvious to every one that the locomotive on four wheels was the principal one, and it seems proper that engines of this sort should no longer be employed."

To this paper M. Biot adds a note, in which he points attention to the fact that the death of the victims of this accident was due to their being locked up, and mentions, that on the St. Etienne and Lyons railway the carriages of the passenger trains are always separated from the engine and tender by an empty waggon, which, moreover, carries a spare axle; and that, by means of a simple contrivance, the train can be instantly detached from the engine at the will of the conductor. This contrivance, it may be mentioned in passing, is due to M. Bergeron, a highly intelligent young French engineer, who gave an account of it at the late meeting of the British Association. M. Biot adds, that the structure in general of railway carriages presents only an adaptation of the common road carriage to railway purposes; and that those employed on the Belgian railways are of a very superior design. He suggests that there is much room for improvement in the construction of railway coaches, and instances, as showing the value of appropriate contrivance, that the freedom from any accident of the Parisian omnibuses is to be attributed chiefly to the ease of entrance and egress, &c. given by their peculiar construction. M. Elie de Beaumont adds, that on the Belgian railways the passengers are never locked up—and gives his opinion that the use of two engines to one train is dangerous, and should be abandoned. As each engine has its own chance of accident, we thus *double the danger*—but still further, if one engine meets with an accident, it tends to derange the second, which, in its turn, by still forcing on the train, aggravates the danger due to the first. He considers that the mutual action of two engines, which cannot be made to work exactly with a coinciding action, tends to produce accident. He would not permit the use of more than one engine to each train, except to mount slowly an incline, and recommends the construction of brakes, that could be applied instantly and simultaneously to the whole train; and that one or more wagons, filled with some elastic material, should precede and follow each train of carriages.

At the next sitting of the Academy, on the 16th May, M. Perdonnet (who, it will be recollected, was engineer of the line) read a note, or memoir, which is chiefly an endeavour to set aside the conclusions of M. Combes, previously stated. He proposes to consider three questions, bearing upon the causes of the accident, viz.—

1st, Are four-wheeled engines really more dangerous than those of six wheels?

2nd. When a four and a six-wheeled engine are coupled to one train, is it dangerous to place the four-wheeled one in advance, or should it be behind the other?

3rd. Would the use of small trains on the Paris and Versailles (left bank) railway be more or less dangerous than large ones, as at present?

On the first question, he comes to the conclusion that four-wheeled engines are not more dangerous than six-wheeled, and are better for going round curves.

His arguments are chiefly the authority of certain lines of railway in England, the non-condemnation of them by the Committee of Parliament on railway accidents—the fact, that if the fore-axle break either in a four-wheeled or six-wheeled engine, the foremost end falls forward, and the whole is thrown over—and that in the four-wheeled, if the driving-axle break it cannot let the engine down, as it is between six bearings—that in Stephenson's six-wheeled engines, without flanges to the driving-wheels, if the fore-axle break, the engines must run off the line—that on curves, the whole weight of the engine is sometimes borne by four of the wheels, and hence, the rails are broken by the enormous weight and the engine runs off the rails—and, finally, that experience on lines, where both sorts are used, or either exclusively, there is no difference in the amount of accidents.

On the second question he concludes, that the four-wheeled engine *ought* to go first, because less liable to run off the rails; and because a broken fore axle is as bad for one as for the other; and, lastly, because in gradually gathering up the heavy train, the less powerful engine should be in advance.

On the third question he concludes, that heavy trains are more safe and convenient than a greater number of lighter ones, on this particular railway, where lighter trains would have to start, at least on holidays, from each terminus, every quarter of an hour; and where any delay would be almost sure to cause the trains to run into each other; and would produce great danger in the very many crossings of roads on the level of the rails. He contends that two engines are better than one, applied to a heavy train, because by their weight they give the power of rapidly stopping, in case of an obstacle ahead; and he thinks a train of 30 carriages, drawn by three engines, would be safer than three trains of 10 carriages, each drawn by one engine, because it is possible that a broken axle of an intermediate engine might not, (by the traction of the others,) be permitted to stop or derange the motion of the train until it would be stopped.

He considers a moderate speed essential, and that the serious nature of the accident was due to a peculiar and rare coincidence of unusual circumstances, viz., the breakage of a fore-axle, and just at the passage of a public road over the rails.

Lastly, he recommends the adoption—

1. Of the attachment-hook of M. Bergeron, before mentioned.
2. The making the carriages of incombustible wood. (He says nothing as to the other materials composing them.)
3. The use of wagons before and after the train, loaded with inert matter.
4. The establishment of an examination as to knowledge and ability, &c., of all locomotive engine-drivers, plate-layers, &c., and *giving them diplomas*.

Mr. Perdonnet entertains some doubts of the possibility, in a fiscal point of view, of adopting the third proposal.

The views contained in this memoir are not to be neglected; but they are, many of them, flimsy in the extreme, and throughout there is manifest a special pleading to prove that the arrangements made on the line, at the time of the accident, were the best that human wit could devise, and that no blame is any where attributable.

At the same sitting there was also read a memoir from a M. Manby, called "A Defence of four-wheeled Locomotives." The arguments are almost precisely the same as those preceding, with the addition of developing more fully the causes why six-wheeled engines fall forward

when the fore axle breaks. The only cause assigned, which has any pretension to novelty, is, that of the *reaction* of the issuing steam, &c., from the blast-pipe and funnel. The author concludes, that the fracture of a fore axle of any engine, of whatever sort, or of a carriage, must produce a sudden stoppage, and probably an accident; but denies that the number of wheels, &c., had any thing to do with the accident of the 8th of May, the real cause of which, however, he does not specify.

*Twenty-two* other communications were addressed to the Academy, and are not published, but referred to the commission appointed upon the previous memoir of M. Perdonnet. The commission consists of Arago, Poncelet, Coriolis, and Leguier.

A long letter was also read by M. Delessert to the Academy, from M. Prevost, who, it appears, is employed upon the London and Birmingham line, and describes the practice as regards engines, &c., on that line. There is in it nothing very much to the point, or new to English professional readers. M. Prevost is altogether in favour of four-wheeled engines, *which alone are used on his line;* and attributes the accident solely to excessive speed: he would prohibit any speed upon inclines beyond 30 miles per hour.

On the 23rd of May, M. Franchot brought before the Academy his contrivance for preventing a shock to the train, whenever the locomotive preceding is stopped by any cause. The contrivance consists in connecting the engine to the train by a series of jointed parallelograms, like a "*Lazy tongs*," which are stretched at length while all goes on right; but on the stoppage of the locomotive, the parallelograms are forced together, and each is reacted on by a spring. It is, in fact, a plan of uniting, in succession, a great number of separate buffers, and is not devoid of ingenuity.

Another plan was also brought forward by M. Jouffroy, for effecting the same object, by means of brakes, acting constantly upon each individual carriage, and only relieved by the traction of the engine upon the draw-bar in front of the carriage. As soon as the traction ceases, from any cause, the brake of each carriage instantly begins to act. No details are given, but a plan is said to have accompanied the communication. It is hard to see, however, in what way some of the difficulties of detail are to be got over; for instance, how the train is to be started with all the self-acting brakes on, or how backed.

Seven other communications, not published, were also received, and the whole referred to the commission to report upon.

(To be continued.)

### THE DISC PHENOMENON—FIRST OBSERVED BY MR. ROBERTS, OF MANCHESTER, AND NOT BY M. CLEMENT DESORMES.

Sir,—In your valuable Magazine for July 9th, 1842, is a communication from Mr. W. Wynn on what he calls "the disc problem," to which you have appended a note, stating that "The phenomenon alluded to by your correspondent was first noticed by M. Clement Desormes." This has been often said, but is nevertheless erroneous, as that gentleman first saw it exhibited at the works of Messrs. Sharp, Roberts, and Co. of Manchester, in company with the late Dr. Henry, of the same place.

I herewith send you a copy of a paper read to the Literary and Philosophical Society of Manchester, many of the members of which were cognizant of the facts respecting my first observation of the phenomenon,—the visit of M. Clement Desormes, to whom it was shown,—and his subsequent statement respecting it. That statement did not, however, distinctly affirm that it was first noticed by him, but merely gave the fact that such phenomenon had been observed, leaving it to be inferred by the reader, that it was then observed for the first time. The paper which I send was published in the Memoirs of the Manchester Literary and Philosophical Society, with the note explaining that M. Clement Desormes first saw the phenomenon in Manchester; and I believe that that gentleman has never denied the correctness of the explanation given in the note.

The cause of truth and fair dealing induces me to request that you will insert this in your Magazine and should it appear to you advisable, also some extracts from the paper.

I am, Sir, your obedient servant,

RICHARD ROBERTS.

Manchester, August 11th, 1812.

The printed paper which Mr. Roberts

has been so good as to send us along with the preceding communication establishes incontrovertibly, that the merit of having first observed the remarkable phenomenon in question rests entirely with him. It is a pity that a philosopher of M. Desormes' eminence should not have had candour enough to spare Mr. Roberts the trouble of thus reclaiming his own. The paper is entitled "Experiments and Observations on Diverging Streams of Compressed Air," and was read before the Literary and Philosophical Society of Manchester, March 9, 1827. The author is Mr. T. Hopkins, but the experiments related, as will be seen by the following extracts, were made by Mr. Roberts, with the assistance (latterly) of the writer of the paper:—

"On the eleventh of October, in the year 1824, Mr. Roberts affixed a valve to the aperture of a pipe, used as a waste-pipe, for the purpose of regulating or equalizing the force of a blast of air which was blowing a furnace. To his surprise, however, he found that the valve, instead of being readily blown off by a strong blast, remained at a small distance from the aperture of the pipe, and was removed to a greater distance only by a considerable exertion of the power of the hand. This singular phenomenon was witnessed by many gentlemen, members of this society, in the same week, and appeared to be viewed by them all, as equally new and extraordinary.*

"Mr. Roberts made some experiments on his air-valve at the time, and various theories were then suggested to account for the adherence of the valve to the pipe. It was not, however, until the month of September in the present year 1826, that I agreed to join him in making further experiments, a part of which I now proceed to give.

* * * * * *

"The valve was attached to one end of a scale beam by a string, and balanced by weights placed in a scale, attached to the opposite end of the beam. The valve being thus placed on the seat, without any weight of its own to press downward, the stream of compressed air was admitted into the pipe, when the valve rose from the flange or seat, 1-32nd of an inch, and there remained stationary. Thirteen ounces, avoirdupoise weight, were now put into the scale, which raised the valve to 1-12th of an inch above the seat. Twenty-six ounces raised it to 1-8th of an inch, and thirty-two ounces raised it to 1-4th of an inch, but any weight beyond this last caused the valve to fly abruptly off.

"It thus appeared, that when the valve was raised from its seat a quarter of an inch, there was the greatest difference between the force of the issuing current of air pressing against the *under* side of the valve, and of atmospheric pressure on the *upper* side of the valve. The pressure of the atmosphere was greater than the force of the issuing stream of previously compressed air, a weight of thirty-two ounces being requisite to establish an equilibrium.

"That we might ascertain what was the state of the stream of air under the valve, in different parts of it, four double syphon tubes were procured, and proper quantities of mercury being put into them, they were inserted in holes made through the valve at certain distances from each other. The inserted limbs of these tubes being thus left exposed to the action of the stream of air, the compressed air was again admitted into the pipe, and the valve rose as before, 1-32nd of an inch.

* * * * * *

"From a general view of the results thus obtained, it appeared that while the valve adhered to the seat, and remained at but a small distance from it, a circular stripe or flat ring of attenuated air was found between the valve and its seat, and near to the aperture, the air at the same time in the parts further from the aperture becoming more dense, until close to the periphery it became nearly of common atmospheric density; but as the valve was raised, the ring of attenuated air approached the outer part or periphery of the valve.

"To find the form and nature of this ring, it now appeared desirable that the different heights of mercury in the same tube, indicating degrees of vacuum should be ascertained at small and equal distances, beginning at the edge of the aperture, and proceeding along a radial line to the periphery of the valve.

* * * * * *

"These experiments showed, that until the valve was raised to a certain height above its seat, the under side of that part of the valve which was over the aperture, was exposed to a pressure of $1\frac{1}{2}$ inches of mercury more than atmospheric pressure; and the under side of all the rest of the valve, forming an outer stripe or ring, was exposed to a pressure less than atmospheric, or had a partial vacuum varying from one and 8-10ths of an inch of mercury up to atmospheric

* Monr. Clement, of Paris, was, I understand, in Manchester at this period, and saw the air-valve adhere to the pipe, yet he afterwards, it appears, represented the discovery to have been made in France long subsequent to the time he saw it at Mr. Roberts' works.

pressure. The superior pressure against the under side of the centre of the valve, must then have been counterbalanced by the inferior pressure against the under side of that part of the valve which is nearer to the periphery,—and more than counterbalanced, for atmospheric pressure on the top of the valve was still so superior as to admit of a weight of 32 ounces being applied, before that pressure could be overcome and the valve raised.

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"In endeavouring to account for these phenomena, it appeared, that the air in the aperture was projected or driven from the aperture as from a centre, in radiant lines in every direction through enlarging circles, and thus became attenuated as it was thrown off from the centre, in the way that light is diminished according to its distance from its radiating point.

* * * * * *

"When the circular valve is placed on the seat, there is stagnant atmospheric air within the aperture. On the condensed air being admitted into the pipe, the stagnant air is put into motion, and before it can overcome the inertia of the valve, is forced between the outer parts of the valve and its seat. The air, while being thus forced is, however, compelled to diverge from a circle, whose diameter is 2¾ths to one of a larger diameter, and is consequently dilated and attenuated. The impulse given by the compressed air on its first admission to the stagnant air in the pipe, causes the stagnant air to commence the process, but the compressed air follows instantaneously, and through the force with which it is impelled by the original moving power, is projected under the valve, and there forced to diverge with a velocity proportioned to the amount of the projectile force.

"The projectile force acting through the stream of compressed air, and the peculiarly shaped and confined space through which the air is driven, are then the causes of its dilatation, until its degree of rarity is beyond that of the atmosphere, when atmospheric pressure on the upper side of the valve preponderates.

"This view will, perhaps, be illustrated, by supposing the compressed air at the edge of the aperture to be an elastic ring of 2¾ths diameter, and that every part of this ring shall be struck with equal force from the centre, in a radiating direction to the circumference. By the time that the ring is projected to a sufficient distance to be a diameter of, say 4 inches, it will be stretched from a smaller to a larger circumference, and every part of the ring will be equally stretched or attenuated. It is not however necessary that the substance projected should be elastic, for if the ring were made of lead, the effect would be the same; or if grains of sand, or small lead shot, could, in like manner, be thrown from a centre, in all directions around, it is clear that as they were removed farther from the centre, the grains or shot would be more distant from each other, or the stream of them would be more attenuated.

"It has been suggested, that the formation of the vacuum may be accounted for from the known tendency of a compressed spring, when liberated, to fly beyond the point at which it will finally settle. But this action of a spring is only one instance of the operation of a general law of nature which is applicable to all bodies. When any body elastic or non-elastic is put in motion, its inertia causes it to continue in motion in the direction in which it has been impelled until its force is expended. The force of a liberated metallic spring is expended in the effort to overcome the tenacity of the substance of which it is composed, while the force of a cannon ball, fired into an earthen bank, is expended on the resistance presented by the earth; but it is projectile force that is expended in both instances.

*Addenda.*

"In a short time after the phenomenon of the adherence of the air-valve was observed by Mr. Roberts, he ascertained, by experiment, without knowing that it had been done before, that *water*, when forced through a conical pipe, with considerable velocity, will draw out other water, placed below in an open vessel, if one end of a small tube is inserted in the conical pipe, and the other end is immersed in the water, in the vessel below: thus showing that water, an inelastic fluid, produced the same effect that air did, when rushing out in a stream, confined in a peculiar manner. And at the time this paper was going to press, water was, by pressure from a column of considerable height, made to issue from a pipe with a valve placed over it, when the valve, instead of being forced off by the issuing stream of water, was found to adhere to the seat, at a small distance from it. And when the apparatus was inverted. and the valve consequently placed below the seat, upon the water being permitted to flow, the valve, instead of obeying the law of gravity and falling by its own weight, or of being driven off by the force of the stream of water, adhered, with considerable firmness, to the seat."

## APPENDICES TO MR. WEALE'S NEW EDITION OF TREDGOLD ON THE STEAM-ENGINE AND STEAM NAVIGATION.

Mr. Weale has recently published two very useful Appendices to his excellent edition of Tredgold on the Steam-engine and Steam Navigation.

The first, (called Appendix C,) is by that industrious and promising young engineer, Mr. Samuel Clegg, jun., whose "Practical Treatise on Coal Gas" we had occasion some time ago to commend to the favour of our readers; and is occupied entirely with the well-known *Gorgon* engines, as fitted to H. M. S. *Cyclops*. "For a correct delineation of our subject we are indebted," says Mr. Clegg, "to the liberality of the Messrs. Seaward; the late Mr. Samuel Seaward, whose premature death we have to deplore, having expressed his anxiety for a thorough investigation of the *Gorgon* engines, and which it is now hoped will be duly appreciated and valued by the profession." It will naturally be inferred from this, that "a thorough investigation" is what is contained, or at least attempted, in this Appendix. Strange to say, it contains nothing of the kind! On the contrary, Mr. Clegg is at pains to assure his readers, beforehand, that "*no attempt will be made to solve questions which admit of discussion*, or have been contradicted, or differently answered by different authors—no theories will be given—*no examinations of merit will be entered into;* but merely simple explanations given of the engines *as they are* —the work they actually perform—not *what they might be made to do*." (Page 3.) "Thorough investigation," therefore, there is absolutely none—nothing of the sort, to be "duly appreciated and valued by the profession." The utility—by no means small—of Mr. Clegg's Appendix—consists solely in its giving an exact and minute account of "the engines as they are," and "the work they actually perform." We are disposed, however, to blame Mr. Clegg less for not trying his hand at the "thorough investigation," than for sundry not very wise reasons which he gives for refraining from the attempt. "It is not opinions which are wanted now, for they are already various." "Much has been said about the *Gorgon* engines—much both for and against—ingenious arguments have been used on both sides, but the end finds us exactly as we were at the beginning." "In every description of steam-engine, and in all machinery whatsoever, there is some fault; no class of work is perfect, and it would be unreasonable to expect the absence of every defect in the *Gorgon* engine." All this, and much more to the same effect, we feel bound in friendly sincerity to tell Mr. Clegg, is sad twaddle. Words—nothing but words. We should be sorry to think that he is unequal to the task of such a "thorough investigation;" but we must at the same time confess, that we never met with reasons for not grappling with a subject, which savoured more of inability to do so. Where, after all, exists the necessity for "the thorough investigation" talked of? We cannot help thinking that Mr. Clegg must have greatly misunderstood "the anxiety" which the late lamented Mr. S. Seaward "expressed" on this point. Mr. Samuel Seaward was not ignorant, of course, of the excellent explanatory pamphlet on the *Gorgon* engines, written by his brother, Mr. John Seaward; and the utmost he could have meant to convey to Mr. Clegg must have been, a wish to have the arguments of that pamphlet weighed, sifted, and tested, in every possible way.

The plates illustrative of the construction of the *Gorgon* engines are ten in number, and produced in a style which does unexceptionable credit both to the author and publisher. Some valuable assistance in this department, from Mr. E. J. Biven, late draughtsman to Messrs. Seaward and Co., is very gratefully and properly acknowledged. They are all "given to a working scale, or with figured dimensions."

From the letter-press explanation we must find room for a few extracts:—

### *The Slides.*

"The slides, which admit the steam above and below the piston, and open passages therefrom to the condenser, are those patented by Mr. S. Seaward in 1835, and are peculiar in their construction, quite independent of one another, and therefore capable of separate adjustment. Any degree of expansion can be given to the steam by altering the throw of the steam slide by the grooved lever and horizontal rod: the slides themselves are of cast iron, 3 inches thick,

11 inches deep, and 25 inches wide, faced against a cast-iron packing piece, dovetailed into the nozzle, and jointed with elastic packing. The slides are kept up against the packing pieces simply by the pressure of the steam.

"The exhaustion slides are kept tight by the effects of the partial vacuum behind them, and work against a packing piece on the side nearest to the condenser.

"The steam slides are attached to their rods by knuckle joints, which suffer them to open outwards, should they be acted upon by undue pressure inside the cylinder, thus forming safety-valves.

"The adjustment of the slide is such, that when the piston has descended $\frac{3}{4}$ths of its path the steam is shut off, and when quite at its bottom stroke, the lower slide-valve is open $\frac{5}{8}$ths of an inch, and the upper exhaustion slide open $2\frac{3}{8}$ inches.

"The area of the steam passages is $3{\cdot}25 \times 21 = 68{\cdot}25$ square inches, being in the ratio of 1 to 47·13 of the area of the cylinder.

"The area of the exhaustion passages is $5{\cdot}25 \times 21 = 110{\cdot}25$ square inches, being a ratio of 1 to 29·17 of the area of the cylinder."

*The Saline Detectors.*

"The Saline Detector applied to the present boilers consists of a glass tube fastened on to the front of the boilers, and open to them below the water level, containing, therefore, water of the same density. Two glass hydrometer balls are placed within it, one heavier than the other, but the weight of both being greater than their bulk of sea-water, when containing $\frac{1}{32}$ of salt, they remain at the bottom of the tube in the first instance. When the evaporation and saturation has continued until the water contains $\frac{5}{32}$ of salt, the lighter ball rises to the surface, and it becomes necessary to blow out. The second ball is adjusted to rise when the saturation is equal to about $\frac{6}{32}$, which is beyond the limits prescribed by practice. The "blow-out" pipe is carried to within a few inches of the bottom of the boilers, so that the more dense water is ejected; and when the lighter hydrometer ball sinks again, the blow-out cock is shut.

"The safety-valve loaded to $3\frac{1}{2}$ lbs. per square inch insures the boiler against an explosion; but the engine-man requires a gauge to enable him to keep up his steam to the proper elasticity, and this instrument consists simply of an inverted syphon-tube of wrought iron, partly filled with mercury, open to the steam at one end and to the atmosphere at the other. The pressure of the steam, therefore, depresses the mercury in one, and causes it to rise an equal height in the other leg: a rod of wood, floating on the surface of the mercury in the latter, marks lbs. upon a scale of inches. The bore of the tube must be equal in both legs, otherwise the mercury will not rise so much in one as it sinks in the other, and, as a consequence, will not show the pressure correctly.

"The atmospheric or reverse-valve is added to the boiler to guard against the effects of *external* pressure, as the steam cools after the fires are let down. It is sometimes considered sufficient for this purpose to open the safety-valve, but a reverse-valve is now generally added: it consists of a valve fitted against a seat, and opening inwards, being kept shut by a small lever and weight."

*Steaming Capabilities.*

[Extract from a letter from Mr. Frederick Robinson, Mate of the "Cyclops," to Mr. Weale, dated Alexandria, 17th April, 1842.]

"The steam can be raised from cold water, temperature 60°, in about 75 minutes, with about $\frac{2}{3}$rds of a ton of coals. After two years' experience, it is found that 24 hours' consumption averages $21\frac{1}{4}$ tons, or about 1 ton per hour, equal to about 7 lbs. per horse power per hour, and which, at an average rate of 8·4 miles per hour, leaves the expense of steaming about 3*s.* 10*d.* per mile, if we use the following prices for the consumable stores, viz.,

| | |
|---|---|
| Coals, per ton......... | 30*s.* |
| Oil, per gallon........ | 4*s.* |
| Tallow, per lb......... | 5*d.* |
| Oakum, per lb. ...... | 3*d.* |

And these are believed to be the average Mediterranean prices.

"The maximum speed attained by *Cyclops* is thought to have been 11 knots, though there has never been more than 10·5 registered in the log-book; this is when in *good trim for speed*, having about 100 tons of coal on board, and drawing between 15·3 to 15·6 forward, and from 15·9 to 16·3 aft. The *average* speed in moderate weather, with between 200 and 300 tons of coal on board, and drawing 15·9 forward, 16·6 aft, or thereabouts, is 9 knots.

"As a frigate she is most serviceable; and, but for her want of power, could scarcely be improved upon. It is principally in towing heavy ships that her want of power is most conspicuous: her burden, as before stated, is 1,195 tons, while her engines are but 320 horses. Her rate of towing the line-of-battle ships and small three-deckers, (like the *Princess Charlotte*,) has been 6 or 6·2 knots per hour; and the

expense of taking them to sea, out of Malta Harbour, has been estimated at 3*l.* 10*s.* each vessel. The fuel used has been chiefly Scotch and Welsh, and, when *mixed*, has been found to burn well; but if used separately, it has been found that there is a difference of nearly *one* pound per horse power per hour in the consumption, the Welsh being the most extravagant. It is a difficult matter to arrive accurately at the wholesale consumption, for it is a common complaint in the service, that the quantities of coal stated in supply notes from the dock-yards always greatly exceed any estimate or measurement for consumption; there being always a great difference between supply and expenditure."

*Expense of Steam Frigates.*

"As the expense of the year 1841 may be interesting, I shall here quote it: it will give an idea of the estimate for a steam navy.

"During the year 1841 the *Cyclops'* services were as follows:—

*Under Steam.*

1462 hours = 10·619 miles; maximum 10.2.

*Under Sail only.*

624 hours = 2·95 miles; maximum 8·2.

| | |
|---|---|
| Coals, 1462 tons, at 30*s.* ........ | £2,193 |
| Tallow, 1830 lbs., at 5*d.* ........ | 38 |
| Oil, 183 gallons, at 3*s.* 2*d.* ...... | 29 |
| Oakum, 18C lbs., at 2½*d.* ........ | 1 |
| Wages........................ | 5,300 |
| Provisions .................... | 3,589 |
| Other stores, wine and tea, say about | 500 |
| | £11,650 |

Or rather less than 1,000*l.* for each hundred tons burden."

The second of these Appendices (called Appendix D) is devoted to the subject of "The Archimedean screw, or sub-marine propeller," and is written by Mr. Elijah Galloway, the author of the "History of the Steam-engine," and inventor of the paddle-wheel known by the name of Morgan's wheel, as also of the divided or cycloidal paddle of more recent date.

Mr. Galloway gives first a "history of the invention." He finds traces of it in the "Machines et Inventions approuvées par l'Academie Royale des Sciences," 1727—1731; also, in a work by Paucton, "on the Theory of the Screw of Archimedes," 1768; and, what is more remarkable, produces documentary evidence of its having been successfully applied in the British navy as early as 1802, (by manual power of course,) to move ships of war in action. The inventor of this British application of it was a Mr. John Shorter, of Wapping Wall, from whom Mr. David Napier obtained, at a subsequent period, the particulars disclosed in the following extract—

"Mr. Napier having made some experiments with a screw which he believed to have originated with himself, showed it to various persons, and thereby became acquainted with Mr. Shorter's previous trials; and having found that person to be living in Southwark, he called upon him at his residence, and was shown a large collection of models of the screw propeller applied in the dead wood, the quarter, the bow, at the vessel's sides, and, in short, in every possible position. The screws also were varied in their form, consisting of one continuous thread, of two, three, and four threads, of mere vanes, like a windmill, and of a single arm. Indeed, Mr. Napier states that he appeared to have contemplated every possible arrangement, and that his models comprised most of the modifications now before the public. He showed Mr. Napier a number of experiments in a reservoir he had constructed for that purpose in his workshop, by which it appeared that the best performance arose from a single blade or arm projecting from an axis, and this seems to have been the form he used in its adaptation to the vessels referred to in the certificates. The position in which he fixed them is doubtful, but the impression is that they were placed one in each quarter, the axes passing through stuffing-boxes."

Marestier, in his memoir on the steam navigation of the United States, 1824, described several methods of propelling on the principle of the screw, which had been either "tried or proposed." A year later, Mr. Samuel Brown, the inventor of the gas vacuum engine, applied a propeller on the principle of the screw to a small boat (at the bow) which he had fitted with his new engine—

"With this vessel several trips were made, principally between London Bridge and Battersea, though occasionally below bridge. In this vessel, we are informed, there were sometimes as many as thirty persons carried at once, at an average speed of 6 to 7 miles per hour. On one occasion, she passed through Battersea Bridge at the same time as the *Diana* Richmond boat, and passed the current in less time than the *Diana*, though the latter is stated to have been 20-horse power."

Tredgold mentions several other parties by whom the idea of screw propul-

sion was at different times taken up, tried, and abandoned.

But though all these facts show that the propelling power of the screw is "no new discovery," they prove at the same time that it had never been turned to any practical account down to the recent period, (1836,) when Mr. J. P. Smith brought it so prominently under the notice of the public, by his patents, and by his successful experiments with the Archimedes. Mr. Galloway pays a well-merited tribute of praise to the Messrs. Rennie, for the active and public-spirited part which they have taken in carrying out Mr. Smith's plans to a successful issue. After describing some experiments which Mr. Smith had made with a small model vessel, he thus proceeds—

"The results of these trials were so satisfactory as to lead to the formation of a Company under the title of 'The Ship Propeller Company.' The system of propulsion was, however, so unpopular among manufacturing engineers and scientific men generally, that it was some time before a manufacturer could be found to undertake an order to construct the engines and machinery for a large experimental vessel. Messrs. George and John Rennie (sons of the celebrated Mr. John Rennie) having, however, witnessed several trials with the little experimental vessel, and satisfied themselves that the invention was one of considerable promise, not only undertook the order, but contributed largely towards the necessary funds for carrying out the designs of the Company. It may be interesting to state that an invention which has been so far established that it has now become a subject of honourable competition to discover and apply the best arrangement of machinery and form of propeller, was, at that period alluded to with ridicule, or at best with expressions of regret that Messrs. Rennie should sport with their reputation and a Company with their capital in so hopeless a project. Such facts as these cannot be considered unworthy of notice, as showing the vast difficulties which oppose the prosecution of a new discovery and as proving that the successful practical application of a mechanical invention is attended with as many obstacles, and requires the possession of a quality of mind, almost as rare and as valuable to the community as the highest powers of invention."—p. 12.

The machinery of the Archimedes is then very fully described,* and illustrated by a copper plate, on a large scale, as well as by numerous wood engravings. After this come the experiments made with the vessel under the superintendence of Captain Chappell, with the results of which our readers are already familiar. The conclusion which Mr. Galloway deduces from these experiments is of rather an equivocal character. "As far as the question," he says, "can be decided by such trials as we have enumerated, there can be no doubt that the performance of the screw *has not been proved to be inferior* to that of the paddle-wheel." Neither does Mr. Galloway think it possible to venture further in the way of opinion, "until two vessels of the same form and power (one fitted with the screw and the other with the paddle-wheels) shall have made several voyages, so as to test their comparative advantages in various kinds of weather." And a double experiment of this sort is, it appears, about to be actually made by the Admiralty—orders having been given to fit out the *Rattler* and *Polyphemus*, two sister vessels, with steam engines of precisely the same description and power—the former to be propelled by the screw, and the latter by paddle-wheels.

Mr. Galloway favours his readers in the meanwhile with a mathematical investigation of "the relative value of the paddle-wheel and the screw, as regards the proportion which the propelling effect bears to the power employed." His conclusion on this head is—

"That when the paddle-wheel is at an ordinary immersion, and the slip equal in both systems, the advantage is somewhat in favour of paddles; but that when a vessel with paddles is deeply laden, or rolling considerably in a sea-way, so as to immerse the wheel beyond a certain dip, or when the screw is so constructed as to have less slip than the paddle, the advantage is in favour of the screw. And further, as a beam wind necessarily depresses the lee wheel so as to cause it to be disadvantageously immersed, a steamer with paddles can only partially avail of such a wind; while with the screw there is no such limitation, and canvass can

* We observe, by the way, among this machinery; a "peculiar coupling," as it is styled, (Fig. 10,) which happens to be precisely the same as that made use of in Craven's Chimney Sweeping Machine, of which an account is given in our 990th Number, and which is there supposed by us to be new, and commended as a contrivance "of great ingenuity, and applicable to many other purposes." Not the first instance, by a great many, of a good thing being invented by two different parties, wholly independent of each other.

consequently be used to the same extent as in a sailing vessel. The advantage possessed by the screw in this respect was clearly proved in the trials between the Archimedes and Her Majesty's steamer *Widgeon*, where the latter vessel was *superior* to the former in calm weather or a head wind, but *inferior* with the wind a-beam." p. 37.

The "slip or recession of the screw," Mr. Galloway considers to be almost entirely a question of magnitude; for "if we increase the diameter without altering the pitch, we reduce the slip without increasing the velocity at which it would be required to drive the screw." The increase of diameter would of course increase the surface friction; but not to such an extent, Mr. Galloway thinks, as to make the total friction greater than in the case of paddle-wheels. But whatever the amount of the "slip" may be, it would seem, from a very curious fact, which has recently come to light in the course of some experiments made at Bristol by the parties concerned in the erection of the *Great Britain*, (late *Mammoth*,) that it may be more than compensated by a new source of power derivable from the form given to the stern.

"A series of trials of the *Archimedes* have been made at Bristol with different kinds of propellers, in which the form and number of the threads were varied. The writer has not been permitted to publish these experiments, as they were not considered sufficiently accurate for that purpose.* In one of them the vessel advanced a greater distance than the screw could have propelled her in still water, or, in other words, if the screw had been worming its way through a solid body the vessel would not have advanced so far as she did in the experiment alluded to. This appeared so paradoxical that the author questioned its accuracy, but inquiry has confirmed the fact, while further investigation has furnished a probable reason for the seeming anomaly.

"If we observe the motion of vessels through the water with full after bodies, or, what is the same thing, if we notice the effect of a current acting against the piers of bridges, we find in the immediate wake there is a quantity of fluid which approaches a state of rest, and round which the active current forms an eddy. In such cases, a piece of floating matter will sometimes retain its proximity to the vessel or pier for a considerable time. This obviously arises from the disposition of the water, according to the first law of motion, to continue in the same state of rest or movement. In the case of a vessel the water must fall in to fill up the cavity which the vessel leaves, and in doing so, flows after the vessel in her onward course. The velocity of such current is decreased by constructing the after body with finer lines, which would allow the water to fall into the space more gradually, and more from the sides of the cavity than when the form is full; but such a following current must ever exist even in the most delicate form. The propeller, therefore, being placed in a position where such a current exists, has a force acting against its surface, so that, although it really slips through the fluid against which it exerts its power, its motion in relation to the surrounding and inactive water seems to coincide with the action of a screw in a solid body, and, as in the instance alluded to, even to exceed the progress which such a screw would make." p. 33—35.

The number of threads which should be given to the screw, is one of the many points relating to the present subject still remaining to be determined by experiment; but Mr. Galloway mentions that "a sensible improvement was produced in the speed of the Archimedes by substituting the double thread for the original single one."

In the case of the *Archimedes* there was but one screw employed, which was placed longitudinally in a hole cut in the dead wood immediately before the rudder. Instead of this, it has been proposed to make use of two screws, one at each side of the dead wood, or one at each side a-midships. Mr. Galloway thinks rather favourably of the former plan, but entirely condemns the latter.

The means of communicating motion from the engine to the screw are investigated under the three different heads of *Toothed Wheels*,—*Bands or Ropes*,—and *Contact by Pressure of Smooth Surfaces*. The "toothed-wheel" mode, which was that adopted in the Archimedes, Mr. Galloway admits to be "*not* a desirable arrangement," because of the liability of the teeth to get stripped off "by any sudden change in the resistance or from imperceptible decay." "Bands" of all sorts he objects to because of their "liability to stretch," and of the rapid destruction resulting from the employment of tightening pulleys; and "contact by pressure of smooth surfaces" (more com-

* The results as regards speed were decidedly in favour of the original screw of the *Archimedes*.

monly called *adhesion*) if obtained by a peculiar method of his own, now for the first time submitted to the public, but for a description of which we must refer to the work itself, he seems to consider the most unobjectionable of any.

We entertain a very favourable opinion of Mr. Galloway's "own;" but at the same time we feel bound to remark that he has done any thing but common justice to the "band" system. *All* bands do *not* stretch, not at least at any strains to which screw shafts can ordinarily be exposed: the metal bands, for example, of Newall; and if the existing fact were otherwise, it would not, we apprehend, be difficult to devise a band that would be as unstretchable as any solid cylinder ever produced.

Again; bands, when they do break, can be readily repaired or replaced, while wheels stripped of their cogs, or of any number of them, are either beyond repair, or must remain as they are till the vessel returns to port. For these reasons we consider the band system to be indisputably superior to the toothed-wheel one, and one, moreover, which *will* answer well under all circumstances; though, according to Mr. Galloway, and for the sake (we cannot help suspecting) of better clearing the way for "my own," he places both in the same category of inefficiency.

Mr. Galloway gives by way of *supplement* to "the Archimedean Screw," descriptions of "Ericsson's Propeller," "Mr. Rennie's Spriral Propeller," (*i. e.* the *Conoidal*—its *paternal* and much fitter name,) "Hunt's Propeller," "Blaxland's Propeller," "Mr. David Napier's Propeller," "Captain Carpenter's Propeller," and "Modification by the author," (another design of "my own.")

"Ericsson's Propeller," appears to have been a bit of a puzzler to our author. The average performance of the *Archimedes* during the trial under Capt. Chappell was about 8½ miles an hour; but the *Robert Stockton*, a vessel fitted with "Ericsson's Propeller," "ran (on the Thames, with the tide) 9 miles in 35 minutes," = more than 15 miles an hour. To account fairly for this without giving altogether the go-bye to the "Archimedes" was a matter of difficulty; and so, to get rid of the difficulty, Mr. Galloway places the whole difference to the account of some *possible* difference in "the power of the engines." This we must take leave to say is not investigation *after the manner of Tredgold*, but palpable hap-hazard assertion after the worst manner of quacks and empirics.

Mr. (George) Rennie's Conoidal Propeller is treated more amusingly, though we cannot say more justly or philosophically. It consists, Mr. Galloway tells us, of "an inclined plane wound round a logarithmic cone or spire"—meaning to say (we presume) *of an inclined plane produced by a straight line wound round a cone.* It exhibits, moreover, according to Mr. Galloway, certain "distinguishing features, which are founded on a *close observation* of the forms which Nature has given to the impelling organs of those of her creatures which move through the waters;" but though he admits, (so candid is he!) that it is "a *safe principle to assume*, that the *Great Architect* has adopted the *very best forms* in all his works," he cannot bring himself to allow that Mr. Rennie's "close observation" of this very best of all possible models has been of any practical use. It does not *suit him*, (apparently,) to say that it has, and he does not *like* to say flatly that it has not, (which, however, is evidently his real opinion). But as it was requisite he should say something on the subject, (this *à la Charles Buller*,) he treats his reader to the following precious piece of seeming wisdom:

"The difficulty which we have to encounter in our imitations arises generally either from our not understanding all the purposes of the arrangement, or from our inability to apply them in the same way, or give them the same properties. Thus the propelling effort of the fish is given out by an alternating action, and a form similar to his tail may not be equally well adapted to rotatory motion. The fish is also endowed with life, and his tail is elastic, so that he suits it to the motion of the fluid in such a manner that the form may lose its best properties if not thus regulated and changed at the will of the animal."—p. 54.

And so, because Mr. Galloway cannot, or affects not to understand how a number of rectilineal movements can be converted into a rotary one, (that is, practically speaking,) and fancies, or affects to fancy, that there is something in the "will" of a fish quite independent of its "tail," Mr. Rennie's most scientific and

most efficient propeller is passed over as a thing of no regard!

Not, however, be it confessed, without more than a due share of the "soft sawder." "For, after all," quoth Mr. Galloway, "there is something extremely pleasing in these modifications, which will secure admiration *for their refined elegance and ingenuity*, WHATEVER MAY BE THEIR ULTIMATE EFFICIENCY." Faugh! Why does he not say, at once, *what he thinks*, which is, manifestly, that they are all fudge? Has he any notion how much he insults the objects of his fulsome adulation, by supposing that they can take any pride in "elegance" or "ingenuity," which has not "ultimate efficiency" for its sole end and object?

"Hunt's Propeller" is the next which comes under Mr. Galloway's *killing kindness*. Here he quite omits to state, that the inventor sets no store whatever on the *form* of his propeller, (See *Mech. Mag*., No. 880, for June 20, 1840) and he mentions, *incidentally* only, what is, in fact, the sole distinguishing feature of this very clever invention, namely the combination of the propeller and rudder in one.

"Blaxland's Propeller" fares still worse. It is said to "resolve itself into a *method of making the screw* by substituting circular blades for the triangular plates described and shown as the mode of constructing the screw of the *Archimedes*;" and yet we are told, that "it must *necessarily* be inferior in effect to the screw of the *Archimedes*"—that is, inferior to what it is said to resolve itself into! Neither is any notice whatever taken, (except in the way of literal description,) of what undoubtedly forms the best feature of the Blaxland Propeller—the mode in which the power of the engine is communicated by *bands* to the screw-shaft.

Mr. David Napier's plan consists in placing two wheels, only partially immersed, at the stern of the vessel, one a little in advance of the other, so that the blades of one just clear the axis of the other. "An *iron* steam-vessel," says Mr. Galloway, "has been constructed by Mr. Napier, for carrying this contrivance into effect, which, though obviously defective in form, (her after end terminating nearly in a square, and the propellers, consequently, consuming a large portion of their power in the dead water thus produced,) has attained a speed of 11 miles per hour." Mr. Galloway forgets that he had just before shown, by the Bristol experiments, that a stern somewhat square is the very best form for a screw propeller.

Captain Carpenter, as our readers are aware, employs two propellers, consisting of flat blades of a trapezoidal form, placed in the after quarter of the vessel. "The chief defect" which Mr. Galloway finds with this arrangement is, "the making the blades plain surfaces, instead of sections of screws; the result will either be excessive displacement at the outer portions, or in direct opposition to the vessel's progress at the parts near the centre."

Mr. Galloway's "own" plan is thus described.

"The parts of the screw near the centre expend the greatest portion of their effort in turning the water round without aiding considerably in the populsion of the vessel. The object of several of the inventions we have described has partly been to obviate this defect. The evil may be in a great degree remedied without departing considerably from the form of the screw of the Archimedes. To demonstrate this, let us suppose the inner portion of that screw to be removed, and the outer part to be merely attached by arms radiating from the axis to the leading and after end of the screw, and that to the leading arms a number of cords or flexible lines be affixed. Under such circumstances, if the screw be made to propel a vessel at its maximum velocity, these cords or flexible lines will generate helices in their progress through the water. The pitch of these helices, however, will be less than the pitch of the screw, inasmuch as they will coincide with the actual motion of the vessel, while the screw has a pitch equal to the vessel's motion in addition to its own slip.

"If, therefore, we could construct the part of the screw nearest the centre in the form of the helices thus generated, we might make the screw with threads continued from the axis to the periphery, but without diagonal loss near the centre; and to approximate to this as much as possible, the writer proposes to decrease the pitch from the periphery to the axis, so as to make the parts near the middle coincide with the vessel's motion. We consider its chief value to consist in its enabling us to attach the screw to the axis the whole of its length, as in the case in the screw of the Archimedes, but without the same loss of power."—p. 62.

As regards all that part of the preceding plan which consists in removing the inner portion of the screw, Mr. Galloway

has been anticipated by Mr. John C. Haddan, who patented, 22nd January, 1839, a plan for propelling vessels, of which this was the distinguishing characteristic. "I claim," says Mr. Haddan, in his specification, "as my invention the forming and using of screws with openings or spaces in their threads."

Mr. Galloway's supplementary list might have included several other varieties of sub-marine propellers, as Woodcroft's, Hale's, &c.; but seeing that all those he has described, with the single exception of the Archimedean, or Smith's, are only shown up in order to be dismissed on most frivolous and insufficient grounds, it is scarcely to be regretted that his collection is not more extensive.

Mr. Galloway closes his treatise with an account of some experiments made with the Government steamer *Bee*, to test the capabilities of the screw, which appear to have come to his knowledge when just on the eve of publication, (for they were made only on the 20th, 21st, and 23rd of June last,) and which he admits square but indifferently with the favourable opinions expressed in the preceding part of the work. "The results," he says, "were certainly more unfavourable to the screw than either the experiments with the Archimedes or our calculations would lead us to expect." The *Bee* was fitted up expressly for the purpose of ascertaining, by a sort of experiment which would be free from every objection, what the real power of the screw was; and accordingly the "machinery was so arranged as to propel her either by paddle-wheels or the screw of Mr. Smith." This we consider even a better test than that of employing "two vessels of the same form and power," such as the *Rattler* and *Polyphemus*, the one fitted with the screw, and the other with paddle-wheels; for it is well known that the same lines and same weights do not always in sea affairs produce identical results. Fifteen trials made with the screw applied to the *Bee*, gave an average speed of only 7·358 miles. Mr. Galloway tells us that "Mr. Smith attributes this result to the screw being too small," and that it may be perfectly ascertained whether this is the cause of the inferior results obtained with the *Bee* or not, the Admiralty have ordered "a larger" one to be substituted.

In one way or other there is now a certainty of the question as to the real value of the Archimedean propeller being very speedily set at rest. It appears from the following paragraph that independently of the *Bee*, there are at the present time no less than six vessels of first-rate magnitude, either just completed, or fitting out on this plan—

"The ultimate fate of these methods of populsion is now beyond the influence either of praise or depreciation. Four vessels are already in operation, fitted under the patent of Mr. Smith, and the 'Great Britain,' now building at Bristol, is to be propelled with the screw driven by engines of 1000 horses' power. A vessel of 1500 tons is also just completed at Londonderry, which is to be propelled in the same way. The British Government are fitting the Rattler, which is of 800 tons burden, and has engines of 200 horses' power, to prove the power of the screw by competing with the Polyphemus, which is of the like power and tonnage; and the French Government are fitting three vessels to be impelled by the same agency. Messrs. Rennie and others are also about carrying out their plans on a large scale. The rapid strides which the system has made in the space of two years, before which it was almost universally unpopular, are the best evidence of its importance; and there can be no doubt that if the machinery for communicating motion from the engine to the screw can be rendered simple and durable, this method of propelling will become useful as an auxiliary power, and in certain classes of war steamers, even if it should not be found equal to paddle wheels under all circumstances."—p. 67.

So far as the experiments already made—which have been both very numerous and conducted generally under most favourable circumstances — may justify us in coming to a conclusion, we should say that there is no likelihood that the Archimedean propeller will ever be able to compete *in point of speed* with the paddle-wheel, whatever may be the advantages which it possesses in *point of position*.

How the case may be, if Ericsson's propeller, or any of the others proposed is adopted, we have not as yet the means of judging. Ericsson's plan, though neglected in this country, appears to be making great way in America. Besides the *Robert Stockton*, of which we have before spoken, and the *Clarion*, which was lost on the coast

of Florida, there have been six other American vessels fitted with Captain Ericsson's double wheels—two which ply on Lakes Ontario and Erie, passing through the Welland canal, and four (of iron) which trade between Philadelphia and New York. A newspaper account of two of the latter will be found among the Notes and Notices of our present Number.

Although Mr. Galloway has by no means treated his subject in a way to be generally commended, it is not to be denied that he has collected together a great deal of most valuable information upon it. It may be even admitted that he has, by his mathematical, or *quasi*-mathematical investigations, advanced to some extent our knowledge of its scientific principles. But to qualify a person to wear, with any credit to himself or his employers, the mantle of a Tredgold, he must possess something more than mere industry and a mere smattering of learning; he should be able to sound the depths as well as the shallows of science—have eyes to see the both sides which every question has, and the courage and honesty to pronounce which in his judgment is the right.

THE CASE IN LIFE ASSURANCE—MR. SCOTT IN CONCLUSION.

Sir,—We have calculated from the Northampton Table, where the rate of interest is 3 per cent., that the annual premium is £4. 13*s* 5½*d*., or the whole in one premium £38. 7*s*. 8½*d*., and that when the interest is 4 per cent., the like premiums, are £4. 0*s*. 1½*d*., and £31. 12*s*. 9¾*d*. The annual premiums when the rate of interest is 3 and 4 per cent., by the Swiss Table are £5. 6*s*. 9½*d*., and £4. 11*s*. 7¼*d*. The single premiums being £45. 5*s*. 1¾*d*., and £37. 6*s*. 1*d*.

Supposing the proprietary of such a scheme are to have ⅓rd of the profits arising from deaths, but that the living subscribers are still to receive £100 each at the expiration of 20 years, it is required to determine what the annual and single premiums will be on this supposition?

1st, By the Swiss Table, when the interest is 3 per cent.

Each living subscriber will have a profit of (100—81·74) £18. 5*s*. 2½*d*.; but, if ⅓rd of this profit, viz., £6. 1*s*. 8¾*d*., go to the proprietary, the profits of each surviving subscriber will only be £12. 3*s*. 5½*d*. In this case, instead of £100, each living subscriber will only be entitled to (100—⅓rd of 18·26) £93·913; hence, by proportion, 93·913 : 100 : : 5·339 : 5·685 = £5. 13*s*. 8½*d*. That is, the annual premium will be £5. 13*s*. 8¼*d*., and 81·74 + ⅓rd of 18·26 = 87·827, and 87·827 + 1·806111 = 48·622 = £48. 12*s*. 5½*d*. the single premium.

By a like process, when the rate of interest is 4 per cent., the annual premium will be £4 17*s*. 9¼*d*., and the single premium £40. 1*s*. 9¾*d*. The like premiums by the Northampton Table will be £5. 5*s*. 0¼*d*, and £4. 9*s*. 2¾*d*.; the single premiums being £44. 0*s*. 10¼*d*, and £36. 6*s*. 1½*d*.

There is a curious circumstance respecting the waste of human life deduced from the Northampton and Swiss Tables of mortality. Thus, between the ages of 23 and 43 the mortality of 100 persons by the Northampton Table is 31; and by the Swiss Table, for the same ages and number of persons and period of time, the deaths are only 18; and these numbers are in the proportion of 7 to 4 (almost exactly). Now contrast this with the following extract from Mr. Morgan, vol. ii. page 443.

"During 33 years, from January 1768, to January 1801, the number of assurances (in the Equitable) on single lives had been 83,201, of which number 60,597 were on the lives of persons under 50 years of age, among whom the deaths were fewer than those in the Northampton Table in the proportion of 4 to 7."

And now, Mr. Editor, having answered, as well as I can, the conditions required by your correspondent, Iver McIver, I shall only in conclusion add, that if any Assurance Company were to adopt the scheme mentioned by Iver McIver, and to calculate their premiums from the Northampton Tables, their loss would be most certain, unless they wished to play the same kind of game as the Western Assurance Company did about two or three years ago.

I am, Mr. Editor, yours, &c.,

GEORGE SCOTT.

Cochrane Terrace, St. John's Wood.

## PERCUSSION SHELLS.

Sir,—In the *Jersey News* of the 6th inst., is a rather designedly obscure, yet pompous, announcement, extracted from an American Paper, of a most wonderful discovery, effected in America, of a shot which explodes without a fuse the instant it strikes its mark, and which is said to be the most destructive weapon of war ever invented. Now, sir, if you will please to refer to your own publication of the year 1823, No. 29, November 14, p. 217, you will find it there recorded, that the invention is not that of an American, but mine: that it is not a present day discovery, but of nineteen years standing in the pages of the *London Mechanics' Magazine*, and there described as a *percussion shell*. There it may be read how it was treated by the Board of Ordnance at Woolwich when presented in the *month of December*, 1812, although subsequently proved at Leith, by Col. Miller, of the Royal Artillery, to be of extraordinary power, and therefore of the greatest utility in the service. The *Condemnatory Report*, signed by General Farrington, bears date 15th Jan., 1813. The discovery, if such, was made by me, thirty years before the American *announcement*, and of which brother Jonathan may not be ignorant; for that he and every designer, reads your very valuable Magazine there can be no doubt.

Your inserting the American account and the foregoing *exposé* in your widely extended *Book of Knowledge*, will oblige all patent-right sufferers, as also

Your obedient servant, T. H. PASLEY.

Jersey, August 12, 1842.

P. S.—If an air-tight iron plug or piston in a tin tube, one fourth of which tube contains gunpowder, inserted in a rock or the stump of a large tree, when the plug is suddenly and forcibly driven down, the stone or stump will be shivered to pieces, with much less danger to the operator, and less trouble, as to confining the powder by sand, than according to the customary mode of effecting explosion by a match-rope. The percussion stroke may be given by a weight, the suspending-rope to which is passed vertically over a pulley and continued horizontally to any suitable distance where the quarry-man chooses to place himself. The plug and rope remain for repeated services, and the exploded tube is renewable for a penny at each operation. T. H. P.

### *Extract from the American Paper referred to by Mr. Pasley.*

#### THE EXPLOSIVE BALL.

We, this day, by the politeness of Mr. W. F. Ketchum, of Buffalo, had the pleasure of witnessing an experiment of his newly-invented explosive ball. Mr. Ketchum made six shots—(for the want of a proper target,) —at trees, on the lake beach, from a six-pound brass gun, belonging to the Buffalo Artillery.

The ball is intended to explode on entering the object assailed to a desirable depth. The result of five of the shots was agreeable to the inventor's design—entering the object and exploding—showing the destructive effect of such explosions, to admiration,—the one failing to meet his views, being fired at a tree of about 20 inches in diameter, struck so far from the centre as to glance off on an angle of 32 to 45 degrees, so that it did not explode from want of sufficient opposition to its projectile motion.

Mr. Ketchum says the principle is applicable to all sizes of ordnance, from 6lb. to the largest used in the army or navy—and the nature of the construction is such that there is perfect safety in handling the balls for the purpose of loading, stowing away, or transporting from place to place.

The balls being ready for use before taken on the ground for the experiment, we could discover none of the internal construction—but ascertained that no fuse was in any way attached—and that the explosion is the result of impingement when the balls assail an object. The peculiar formation of the ball, seems to cause it to take a very accurate direction—as the shots were made with more precision than we ever before witnessed—and it appears to us that there is as much accuracy in the direction of the ball as that shot from a cut or creased rifle.

From the result of the trial, we are of opinion that the inventor has accomplished one of the most important objects ever attained in the construction of warlike weapons, and we hope the projector will not fail to meet the encouragement which untiring genius so richly merits.

We also saw a hand-grenade of Mr. Ketchum's invention, which he had designed for use in naval actions—to be thrown from the vessel in close action—from the deck or round top—or in case of boarding, to be used for the defence of forts, when an enemy might attempt to take them by storm.

The grenade is so constructed as to be of suitable size and shape to throw—will weigh about one pound—but may be made to weigh

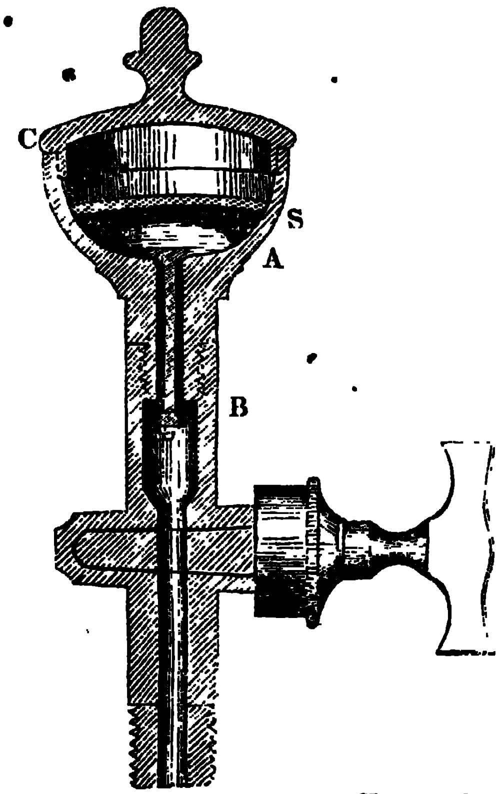
more or less, according to the place of its contemplated use. The formation and principles are such, that it is perfectly safe to handle, stow away, or transport, as occasion may require—yet they are sure to explode when thrown, by coming in contact with any substance as hard as wood, or even by striking a man, and numerous experiments have proved its effects on explosion to be extremely destructive.

Thus with the fullest confidence in the effect of both the explosive ball and hand grenade, we cheerfully ascribe to Mr. Ketchum the honour and ability of having invented and constructed two of the most formidable and destructive missiles of war ever exhibited to the world.

JONATHAN H. FORD,
A. I. ALLEN,
F. D. SPALDING.

Buffalo, N.Y., June 15, 1842.

HOUGHTON'S LUBRICATOR.




(Registered pursuant to Act of Parliament by Messrs. Hornwood and Monkman, Proprietors.)

The ingenious lubricator represented in the prefixed engraving is the invention of James Houghton, a working engineer of Oldham. Messrs. Horwood and Monkman, to whom he has disposed of his right to it, informs us that it is attended with a saving of no less than three fourths of the oil or tallow ordinarily consumed, besides adding considerably to the engine power, in consequence of the nice adjustment of the quantity of oil or tallow supplied, to the wants of the machinery. The operation of the apparatus will be readily understood by an inspection of the engraving. A and B are two valves connected by a spindle which works through a hole in the centre of the cup C. When the steam is pressing on the top side of the piston it closes the lower valve, and when on the under side, the atmosphere closes the top valve; so that at each stroke the quantity of oil or tallow lodged in the space between the valves is diffused over the cylinder. The sieve S, which is inserted loosely in the cup, is intended to strain and clear the oil or tallow of all impurities.

The invention is obviously applicable to all descriptions of revolving or sliding surfaces, as well as steam-engine pistons; a little change in the mode of connecting it, being all that can be at any time necessary, to adapt it to any sort of machinery requiring regular and constant lubrication.

## DR. PAYERNE'S PROCESS FOR PRESERVING LIFE UNDER WATER.

Dr. Payerne has been lately making a number of experiments in the diving-bell belonging to the East and West India Dock Company, to prove the practical application of his process (now patented) for supporting life under water without communication with the external air. The doctor has several times descended in the bell at the West India Import Dock, accompanied each time by an engineer of the Company, and some of the divers usually employed in their sub-marine operations, to the bottom of the dock, a depth of about 25 feet; and succeeded to the perfect satisfaction of all present, not only in confirming the fact of his being able to render the air contained in the bell (after the air-tube had been detached and left on the barge) pure and respirable for the inmates, but in obtaining the very important advantage (which will be duly appreciated by practical men) of restraining the water from rising in the bell as it descends to a great depth, and thus allowing the workmen to carry on their operations with the greatest facility. The engineers of the Company have given Dr. Payerne's certificates expressing their perfect satisfaction with the result of these experiments, and have kindly offered every facility for carrying out the invention.

A fact worthy of notice may here be mentioned. At the last experiment, when four parties, unaccompanied by the doctor, descended in the bell, the small apparatus used for renovating the air was ceased to be worked for about five minutes, when a dense vapour, caused by the vitiated air, immediately filled the bell. The apparatus was then brought into action, and in a few moments the vapour was entirely dissipated, and the air again rendered pure and fresh.

The following interesting exposition of some of the more prominent of the advantages to be derived from Dr. Payerne's discovery we extract from a paper which he has circulated among his friends.

"It has, to the present day, been impossible to make researches in the depths of the Ocean, because there have been no means of existence for the crew of a submarine boat, without communication with the atmosphere. The employment of diving bells, or driving dresses, for the purpose of submarine surveys, has been impracticable inasmuch as the divers cannot go out of the bell, or beyond the range of the air pipe attached to their habiliments.

"By Dr. Payerne's process submarine researches may be prosecuted with nearly as much facility as similar works upon land so far as regards supplying the crew with the means of existence during an indefinite period in a submarine boat, which can be directed at any depths like other vessels upon the surface of the water. His method is to place glass illuminators in the boat by means of which, and by the aid of a lamp which gives a brilliant light, burning as well though surrounded by the water, as in the atmosphere, of which it consumes not the minutest quantity, its progress is illumined, and any object that is near may be distinctly observed. This boat by mechanism fixed in the interior may be propelled at the rate of from 1 to 10 miles an hour; it is under the government of the helm, and is so constructed as to be made stationary at will, at the greatest depths, the divers quitting it to perform their operations with no more cause for alarm at the tempest that may be raging above and agitating the surface, than at the most delightful calm, drawing a sufficient supply of the vital fluid for respiration through pipes communicating with the interior of the boat. By the same means, they can re-enter the vessel without once being obliged to ascend to the surface.

"Under the present system of salvage operations, difficulties are met with which are frequently insurmountable—always very expensive and very dangerous. A derangement in the apparatus of the air pump, the twisting or breaking of the air pipes, &c. &c. inevitably give rise to many accidents of a most serious character. Such operations, indeed, are not only difficult and dangerous, but when required to be performed at very profound depths, are altogether impossible; and they are so for these reasons. 1st. Because a man cannot descend in a diving bell to more than 120 feet below the surface of the water, as he is unable to support the pressure. 2ndly. Because, the air-pump is incapable, when the bell is at a greater depth, of conveying fresh air of a greater density than two or three atmospheres; the air thus conveyed would only serve to repel that which had been vitiated by respiration, and that, thus confined, would immediately suffocate the unfortuuate diver. It cannot be otherwise, for, as it is well known, *one* part of vitiated air renders unfit for respiration *ten* parts of pure air; when this deleterious mixture has taken place, and that under a pressure of several atmospheres, the pump would be required to furnish the divers with at least fifteen times the quantity of air that they respire, or nearly 12,000 quarts per

hour, instead of 800, that is 480 cubic feet instead of 32. The dangers thus indicated are so real and formidable, that but few men can be found with nerve sufficient to encounter them.

"In the new method, to which attention is now invited, the divers are exposed to none of these evils, nor to any of the inconveniences inseparable from the old system; the air in the bell is renovated in proportion as the original supply becomes impure: there are no pipes conducting air from the water's surface, consequently there can be no accident from the twisting or rending of such, or a derangement of the pump. Further than the depth of 120 feet, the divers' operations are carried on by the aid of a sub-marine boat; and to the diving dress a double tube is attached, in length only a few feet, for inhaling and exhaling, communicating with the interior of the boat, and which conveys to the divers, whatever may be their number, the purest fluid for respiration. The apparatus is so disposed, that the pressure of the air in the diving dress never surpasses that degree which it is proper he should have. This facility of respiring and working in the lowest depths of the ocean permits the application of enormous cramp-irons, or other machinery, to the foundered vessel, by which it may be raised to the surface entire, with the whole of its cargo.

"The improved diving-bell has the advantage, we will venture to repeat, of affording air to several divers in diving dresses, while they are at a distance from it at one and the same time, and to others in the interior a perfect security from the intrusion of the water, which is restrained at the very edge of the bell, thus enabling them to proceed without interruption in recovering wrecks, cleansing harbours, laying the foundations of bridges, docks, or other places surrounded by water.

"In a national point of view, the submarine boat adapted to this process must be of the highest importance, as its application extends to the examining of sunken rocks, shoals, reefs; to the ascertaining of under-currents, surveying the bottoms of rivers, harbours, the outline of coasts, &c. &c.; and to the forming of submarine charts, which hitherto has been deemed an impossibility, owing to the very defective means employed.

"In time of war, this submarine boat must become one of the most formidable engines of destruction which modern science has given forth; but, in the hands of a powerful and peace-seeking nation, the most effectual for repelling foreign aggression, and preserving the universe from the evils of warfare."

## WRECK OF THE "TELEMAQUE."

We have received a copy of a Report addressed by Mr. R. B. Grantham, C. E. "to the Subscribers to the Enquiry relative to the *Telemaque*," pursuant to whose instructions that gentleman appears to have been despatched, on a tour of inquiry into Normandy, in order to ascertain all the circumstances of the case. After stating that he has "occupied himself in procuring the best information upon the points specially pointed out by the instructions, and any other which seemed to him to be necessary to put the subscribers in possession of all the facts," Mr. Grantham proceeds to give "a short history of the vessel," which differs, however, in no material respect from the report previously drawn up on the subject by Mr. F. R. Conder, C. E., who first directed attention to the subject in this country, and planned and directed those operations which now appear on the verge of success. With the substance of Mr. Conder's report our readers are already familiar. Mr. Grantham's enquiries confirm, in every respect, the opinion of Mr. Conder, and substantiate to a degree little short of positive verification, these points:—that the *Telemaque* was secretly loaded with specie, bullion, and other valuables to a large amount;—that she was lost at Quillebeuf, on the 3rd of January, 1790;—that it is physically impossible that she can have been robbed of her treasures, either before or after the wreck;—and that the operations which are now so nearly completed, are, beyond question, directed to this identical wreck.

After dwelling on these particulars at some length, Mr. Grantham states, that from the vigour with which the operations are now being pushed on, and the safe and ingenious mode in which the works are planned, he sees every reason to expect that within twenty days the salvage will be effected.

In conclusion, he describes the legal arrangements in virtue of which shares in the salvage are offered for sale, and recommends to his constituents to appoint a local director, who should communicate weekly with the parties at Havre, who have the active direction of the affair.

The following paragraph on this subject we find in the *Moniteur*.

"The Seine near the town of Quillebeuf, presents at this moment a most animated appearance. At 120 metres from the Quay an immense scaffolding, supported by a bridge, surmounted by a tricolour flag, rises, as if by enchantment, from the centre of the river, and marks the spot where the *Telemaque* rests, for a few days longer, buried beneath the waves. This bridge, forming actually a portion of the wreck, serves as a platform for a numerous crew, who are incessantly occupied in passing round the hull the chains destined to raise it. The works have been hitherto carried on with remarkable activity and success, and we have every reason to hope that in three weeks, at the latest, the solution of a problem at once historical, financial, and mechanical will be definitely known."

## INSTITUTION OF CIVIL ENGINEERS.
### APRIL 5, 1842.

"*Observations upon the Sections of Breakwaters as heretofore constructed, with suggestions as to modifications of their forms.*" *By Lieut.-Col. H. D. Jones, R.E., Assoc. Inst. C.E.*

This communication is the result of several years' observation of the effect of storms upon the sea faces of breakwaters and piers: those principally alluded to, and of which drawings were exhibited, were Plymouth, Kingstown, Howth, Ardglass, and Dunmore; a section was also given of the sea wall of the Kingstown Railway, and of the mole of St. Jean de Luz.

The mode of building with "pierre perdue" appears to have been brought into notice about the time of Louis XV., when the cones at Cherbourg were sunk and filled with stones as a foundation for a wall; since then, the general method of constructing sea-defences has been to throw down masses of stone, allowing them to form their own angle, subject to the effect of the sea in giving them a greater or less slope. In many instances this rough foundation has been paved down to below the low-water mark with squared blocks of stone, secured with much care, and above this a wall is built of solid masonry, generally with a considerable slope on the sea face.

The author contends, that the system of assimilating the sea face of breakwaters to the form of the shore at low water is erroneous, because the sea shore is the line of least, or non-resistance, not opposing, but yielding to the sea: he asserts that, as far as he can ascertain, no pier or breakwater constructed with a sea slope has been found to resist the effects of storms, without considerable repairs and expense being subsequently required. He then gives his observations upon the several sections, and states that the waves have the most violent effect at about half-tide; hence, the stones at that line are first disturbed, and then are carried down into the deep water: to parry this evil, nearly 200,000 tons of stone have been deposited on the fore-shore of Kingstown Eastern Pier,—yet more must still be added. Similar additions have been repeatedly made to Plymouth Breakwater, with no better effect. At Dunmore, iron chains have been fixed in the face of the walls to secure them. At Howth, a slope of 3 to 1 has been found insufficient. At Ardglass, the pier-head and lighthouse have been washed away. From these and numerous other examples it is argued, that piers in exposed situations, with a considerable inclination of the sea face, do not resist the violence of the waves, whereas there are many instances of upright walls having resisted perfectly. As instances of this, Old Dunleary Pier is adduced, as being nearly perpendicular, yet never having been injured during a long series of years, although quite as much exposed as the New Pier, now called Kingstown: Kilrush Pier, although not built of heavy materials, has resisted all the shocks of the heavy seas which break upon it from the Atlantic.

From these considerations Colonel Jones proposes upon the "pierre perdue" to rise a perpendicular wall from a little below the level of low-water spring-tides; this form, he contends, would resist the upward pressure of the sea upon the broad bases of the stones, and prevent their being removed. He argues that although the proposed walls would require to be built with squared stones, instead of "pierre perdue," that the cost would not be greater than at present, as the area of the section of his proposed wall if applied at Kingstown would be only 4860 square feet, whereas the sectional area of the present pier is 10,085 square feet. The French appear to have partially adopted this form at the new works at Cherbourg; but he considers this mode of construction objectionable, inasmuch as it leaves in front of the outer face that part of the breakwater which is most subjected to injury.

An extensive series of drawings, containing the plans and sections of existing breakwaters, and piers showing the injury sustained from storms, accompanied the same.

Colonel Jones explained by the various sec-

tions of breakwaters shown in the drawings, the changes of form and the additions to their cubic content which had been made at different periods in consequence of the violent action of storms.

The Plymouth Breakwater has had its form altered three times; each time the base has been extended and the sectional area increased.

At the Howth Pier the sections showed three distinct forms assumed by the mass of materials, in consequence of the varied action of the waves. The damage done is now so extensive, that the sea threatens to make a clear breach through the works.

The sections of the Kingstown Pier showed the original form to have been a slope of 4 to 1 and 5 to 1, covered with heavy pitching, which had been repeatedly torn up, and some of the stones weighing 10 tons were carried to considerable distances: an external mole of rough work containing nearly 200,000 tons of stone which had been deposited upon the foreshore was almost all washed away; while the toe of the work beneath low-water mark, although at a greater angle than the other parts, remained undisturbed.

At Dunmore Harbour, although the long glacis with a slope of 5 to 1 is protected by pitching composed of square stones of from 2½ to 6 tons weight, and above 12,000*l*. has been expended, it has received very extensive damage.

Many other cases of injury to sloped works were mentioned, and it was stated that from these examples, coupled with observations upon some ancient piers in Cornwall and other exposed situations, which although built of rough materials and with a nearly vertical sea face, had resisted the action of heavy seas, the Shannon Commissioners had determined to try, at Kilrush, a sea wall with a very slight inclination, and up to the present time it had sustained no injury, although previously the sloped work had been destroyed.

Colonel Jones, being convinced of the superiority of this form, had devoted much time to observations of the action of the waves upon works of all kinds, as well as to the various modes of using the materials composing the sea-walls; and he felt assured that if the stones were of an average size, square-jointed, and well laid, even without cement, forming an almost vertical wall of moderate thickness, springing from a point as much below low-water mark as could be conveniently attained, the work would be more durable. "Béton" (concrete) was now much used in France for the construction of sea defences: it was generally done by building caissons of ashlar, filling them in solid with "béton" and then caulking all the ashlar joints with oakum: this kind of work was very durable.

In answer to a remark by General Paley, Colonel Jones believed that the greatest injury was done by receding waves, particularly if the joints of the work were not well closed.

Mr. Rennie took a hasty review of the moles and breakwaters mentioned by the early writers, as being thrown out for the purpose of forming harbours; Vitruvius particularly described, among other similar works, a mole constructed with a kind of concrete composed of "pozzuolana."

Mr. Rennie contended that engineers were not in error in taking as their guide the natural inclination of the sea-shore opposite the situation where the breakwater was intended to be placed: it would be found in following the coast of England from the perpendicular primitive cliffs of Cornwall to the flat shingle beach of Norfolk, between which places is found almost every variety of geological formation, that the profile of the sea-shore differed according to the material of which it was composed and the peculiar action of the sea upon it from local circumstances. It had been shown that the force of the waves acted more prejudicially upon the point above low-water than below it; that the work would stand at a great inclination at the latter point, indeed that it was rarely injured even when all above it was carried away; that if the water was deep, the action of the waves would extend deeper: all these and many other points required to be considered in fixing upon the slope for any sea-wall; and therefore he could not accord with Colonel Jones's views in adopting an arbitrary form for all situations, without considering the exigencies of peculiar localities. He had been particularly struck with the regularity of the slope assumed by the materials at the Kingstown pier after a storm: but in that and all similar positions, the inclination of the face varied with circumstances and with the degree of violence of the action of the waves.

Among the many arguments against the proposed perpendicular form, might be mentioned the increased expense; for if built of squared stones below low-water mark, the work must be done from a diving-bell; and also that the form is objectionable for a pier, as the wave is thrown up in a mass, instead of expending its force in rolling over the long slope of the fore-shore.

Mr. Telford had abandoned vertical sea-walls on these and other accounts.

Mr. Vignoles agreed, to a certain extent, (but not fully,) with the form proposed by Colonel Jones: he believed that, although the construction might be rather more costly, it would be amply compensated for by the greater durability; and he saw no difficulty

in doing the work; the proposed plan he understood to be by commencing the foot of the wall only at such a depth below low-water as should prevent the violent action of the waves upon it.

At Ardglass, the upper portion only of the pier is destroyed; all that part below low-water remains perfectly sound: it is of ashlar of large dimensions, placed from a bell.

Mr. Gordon had seen sections of the works which were commenced for forming a break-water at Madras: the materials reached, at the highest point, to within about ten feet of low-water, and amidst the violence of the surf of that coast, the work stood undisturbed at an angle of 45°: it was composed of "pierre perdue."

At Algiers the French engineers had used extensively masses of concrete, (blocks de béton,) but at first they were displaced and destroyed by the force of the seas; the cubic capacity of the masses had, however, been increased to the extent of 2 metres square by 3 metres long; they were floated out, and allowed to drop into their places from slings; and now they succeeded perfectly. The upper part of the work is intended to be of concrete cast in caissons, the section below low-water is at an angle of 45°, and above it like an ordinary quay wall, with a curved "batter."

In allusion to the depth of the wave and the power of its action at Madras, Sir John Robison said that, during a violent storm, a quantity of pigs of lead had been cast ashore near the fort, and it was proved that they had come from a vessel which had been wrecked at more than a mile from the shore, during the siege by La Bourdonnaye.

The President observed, that at the Plymouth Breakwater the largest blocks, (some of them weighing from 6 to 8 tons,) and the greatest number have been washed from the sea face over into the Sound; the square stones with which the fore shore is paved are placed with the utmost care, and little comparative injury has been done since that method has been adopted. Engineers now generally recommend a deep paving of squared stone in bond courses as the best mode of construction. In order to insure the stability of the light-house now erecting at the extremity of the Plymouth Breakwater, a foundation of squared stones has been carried up from the natural rock, and an inverted arch turned below the level of the top of the work; and, for its further security, a buttress is now thrown out upon the foot of the south slope, in order to prevent the stones from being carried away.

It is evident, that if the materials are deposited at an inclination, any portion being displaced is only carried down to where, although strictly speaking it may not be wanted, it must nevertheless assist in consolidating the mass; and the vacant spaces can easily be filled up. Under similar circumstances a perpendicular wall would suffer more severely, and probably would have fallen entirely. He therefore considerd, that in situations like that of the Plymouth Breakwater, which was exposed to a heavier sea than Cherbourg, a long slope for the sea face was essential. Still, there were situations where the form proposed by Colonel Jones would no doubt be available, and the members were much indebted to him for the suggestion, as also for the valuable observations shown in the sections accompanying the paper: he hoped that he would continue them, and that other members, who had equal opportunities and less arduous duties to perform than the author, would give the Institution the benefit of their observations.

## INFRINGEMENT OF PATENT RIGHT.

### *Northern Circuit, Liverpool.*

### August 10.

### *Smith* v. *Watson.*

This was an action for the infringement of two patents granted to the plaintiff, Mr. Andrew Smith, engineer and patentee of a wire rope, in the years 1835 and 1836, the first patent being for an invention of a new standing rigging, composed of iron wire, and the second patent for an invention of an improvement on the first.

The defendant pleaded—1st, that the plaintiff was not the true inventor; 2d, that the inventions were not manufactures; 3d, that the inventions were of no use; 4th, that the inventions were not new as to the public use; 5th, that the specifications were not sufficient; 6th, that the specifications were not duly enrolled; and, 7th, that the defendant did not infringe the patents.—Mr. Hindmarsh appeared on behalf of the plaintiff, and Mr. Corrie for the defendant.

Mr. Hindmarsh, in opening the proceedings, entered generally into the properties of the standing rigging made of hemp, as compared with that composed of wire under the patents which the plaintiff had secured, pointing out the superiority of the latter, both as regards lightness of weight, and diminution of bulk or space in standing rigging, which was important, in presenting less surface to the wind. Another advantage which the wire rope, or rigging, possessed, was that of not being affected, in like manner as the hempen rope, by moisture—in the former case the rope only being influenced by the atmosphere, which was trivial and unimportant; while in the latter, the hempen rope, in wet weather, by absorbing the wet, expands or swells the strands, and thus contracts the rope, which, on again becoming dry, is considerably extended, and thus slackened, requiring, under such circumstances, to be rendered more "taut," while, in many instances, breakages arise. As regards the comparative weights of equal strengths of hempen and wire rope, the latter was not more, on an average, than one-half of the former—thus lightening the vessel to that extent above the line of flotation, so far as relates to the rigging. With reference to the size of the ropes used, the hempen rope was of double the circumference of that of wire, while the expense would be found to be considerably less in the application of the latter, as well as economy secured, from its being less affected by

the weather.* The learned counsel proceeded to observe on the specification and drawings, explaining to the jury the several modes of manufacture. From the descriptions given, we gathered that for standing rigging a series of iron wires were laid in a straight or parallel line, or salvagee fashion; the tension, which in no way diminishes the size of the rope, or lengthens the same, and which is necessary, to obtain an equal strength, being acquired by application of machinery to that object. The specimens submitted to the jury varied from 1½ inch to 3 inches in circumference, and the wires of which such ropes were formed from 50 to 150; the rope thus formed is then dipped in a solution of Indian rubber, and the interstices so filled up; it is then "parcelled," or covered with a binding of woollen list, so as to exclude the moisture, and to protect the wires from oxidation; this being done, the rope is "served over," or bound round with spun yarn, so that, when finished, it represents the appearance of the ordinary hempen rope, with the exception of its being one-half the size of that of hemp. One of the grounds of defence was, that lines, or strings of hemp, forming a rope, or rigging, of a similar construction to that of the wire rope, had been used, such lines or strings having been "served" as with the wire rope or rigging, and thus that there was no novelty in the invention; but he would be prepared to show, and it was perhaps, a question for the court to determine, whether the application of wire, as in this case, was not a manufacture under the Act, inasmuch that, although the application might be the same, the material used was altogether dissimilar. The defence, as he understood it, was, that the manufacture of the two ropes, or standing rigging—that is, of hemp and wire—were similar in their construction, but that the patent could thus be upset he considered absurd, inasmuch that he would, by evidence of witnesses who had been engaged in maritime affairs for many years, prove the superiority of the wire rigging over that of hemp, and give their evidence as to its utility, and the advantages it afforded. With regard to the second patent, that was simply an improvement on the first, in making the loop, or so splicing the wire, as to obtain a firm hold. The learned counsel proceeded to call his witnesses.

Mr. Whellan, seventy-two years of age, was a master rigger in Liverpool, and had been forty years employed in that capacity. He had never known of wire rigging being used before the date of plaintiff's patent in 1835. Has since fitted the *Great Liverpool*, of 1,400 tons, with rigging of that description; the *John Garrow*, *Guadalupe*, and many others; considered the invention as useful, and that the wire rope had a decided advantage as to strength, at the same time that it was less bulky, and consequently held less wind. Witness considered that its application was equally advantageous to sailing-vessels and steamers. The *Great Liverpool* was fitted about five years since, and the *John Garrow* in 1839, which vessel was now in Liverpool, the rigging having stood the weather. Upon the cross examination of this witness by Mr. Corrie, he stated that he had been engaged in fitting steam-vessels for the past twenty years; that the rigging had been, so far as the funnel was concerned, part iron chains, and part hempen rope—the chain being used to prevent ignition by sparks from the chimney.

Mr. Binks was foreman of the plaintiff, and had manufactured the wire rigging. He had, from an early age, been employed under government as a rope-maker, having been thirty-four years in that employment, and, for the past eight years, been engaged by the plaintiff in the manufacture of wire standing rigging and ropes; had never heard of wire rope or rigging before the patent of Mr. Smith; considered it a very desirable thing, and believed that any one might manufacture the article from the description given in the specification, which was so simple, that no difficulty could exist with any practical man; the second patent was an improvement on the first, in forming the loop and splicing, which were imperfect in the original patent.

Mr. Shaw, marine manager of the City of Dublin and Oriental Steam Companies, had heard, by chance, of the patented wire standing rigging, in 1838, he was induced to test it, and accordingly applied it to vessels belonging to the City of Dublin Steam Company; the result had been highly satisfactory, and he had since used it in numerous instances in preference to hempen rope. He considered the invention invaluable, and, as an evidence of the high opinion he entertained of it he had fitted his own yacht with it, and the more experience he had of its properties, and the advantages attendant on its use, the more he was pleased and satisfied of its merits. Not only was there greater lightness of the material employed, but the security and strength of the standing rigging so manufactured, as well as the less resistance it offered to the wind, formed important features as regarded steam-vessels; but the advantages were not confined to this description of vessels, but were equally applicable, and perhaps more so under peculiar circumstances, to sailing-vessels, embracing men-of-war, as there was less surface presented in case of battle to the action of shot, and so far as his own experience went, confirmed, as such was by Mr. Snow Harris and others, the lightning conductors constructed on the same principle by the plaintiff were proved to be superior to any which had been submitted. He was now fitting the *Hindostan* with the like rigging, and had, in fact, adopted it in every instance since he had become aware of its valuable properties. In the tropics the wire rope, he considered, would be invaluable, and, as an evidence of its lasting properties, he stated that he had rigged a vessel which, after three years, was found to be in as good order as when the wire rigging was first applied. As to the expense, he considered the wire rope cheaper, taking strength for strength, as compared with that of hemp.—Mr. Shaw, on cross-examination, stated that he had been connected with, and had directed his attention to steam-vessels for the last eighteen years; that he had never known wires, or rods of iron, to be bound together in a lateral position, but that rods of iron had been connected by rings or eyes, and so applied to the funnels as stays or ropes, but that such were quite

* The following curious calculations are extracted from a printed paper drawn up by the plaintiff and circulated in court during the trial:—"The weight of standing rigging now fitted and afloat in the navy is about 7,000 tons; and, taking the price of hempen rope at 46*l.* per ton, the value of a first outfit for the whole of the navy will be 322,000*l.*, upon which, by using my wire rope for the same purpose, a saving would be effected of 107,333*l.*, without taking into consideration the more than triple time that wire rope will last. It may also be observed, that the wire rope only exposes two-fifths of the surface to the wind, thus rendering ships rigged with wire to those with hemp less leewardly. It appears that 2203 lbs. of hempen ropes thus applied expose a surface of 1,26½ square feet to the wind, whereas, the wire rope, possessing strength as 80½ wire is to 63¾ hemp, exposes only 51½ square feet; and, as the whole surface of hempen standing rigging now fitted in the navy exposes (according to the above calculation) a surface of 860,000 square feet, whereas, the wire rope has only one of 344,000 square feet—leaving a difference in favour of wire rope of 529,112 square feet; and, allowing the mean force of the wind to be 1½ lb. upon the square foot, the power saved on a leeway would be equal to about 4000-horse power, or equal to the canvas of more than the whole of the sails of twenty-four frigates, and the displacement saved would be about 3500 tons, which would be equal to about 700-horse power—making a saving, in all, of 4700 horse power; and if this is called money, by charging 20*l.* per horse, it will be a saving of about 100,000*l.*; and, with the 105,000*l.*, being the difference of the first cost of an outfit, it makes a total of above 200,000*l.* every three years."

distinct and different from the patent of the plaintiff, which consisted of a number of wires bound together, and covered, or immersed, in a solution, and then "served" with spun yarn. The witness was examined at considerable length as to wire rope, or rigging, having been used for other purposes, and reference was made to the Menai and other suspension bridges, but it appeared that the witness had no knowledge of any application of wire in the form patented, the several bridges referred to being composed of chains and rod-iron. Witness had seen a bridge at Rouen constructed of wire, but which was not protected by any serving, or covering, being exposed to the action of the atmosphere—the several wires being hooped, or clamped, together at certain distances.

Captain Bevis, R. N., holding an appointment under Government, at Liverpool, as superintendent of the Mail Department. He had, by the directions of the Admiralty, examined and carefully surveyed the *John Garrow*, an iron vessel, (800 tons) rigged with the plaintiff's wire rope, and had reported thereon; that he found the patent rigging to answer every purpose, and considered it as an excellent invention; the rigging he found to be in a perfect state, having examined it with care; in his opinion the wire rigging had an advantage over that of hemp—upwards of twenty Government vessels had been fitted with that description of rigging.

Mr. Robertson, a rope-maker, was in the habit of making standing rigging; he had rigged thirty vessels with the wire rigging, not of his own manufacture, but with that of the plaintiff's; never knew such description until the patent of the plaintiff's; had read the specifications of the several patents of 1835 and 1837, and could readily manufacture the rope or rigging from the description therein given, and the accompanying drawings.

Mr. Grantham, who is an engineer, and largely embarked in iron ship-building, (the author of a work lately reviewed in our columns,) deposed that having read the specifications, and examined the drawings, he should feel no difficulty in manufacturing the standing rigging, or rope, as therein described; had been practically acquainted with engineering and mechanics for the past seventeen or eighteen years; could not apprehend that the slightest difficulty would present itself to any person in the manufacture under the specification; had never heard of any similar application of iron wire, or rods, as that comprehended in the patent, and which he considered exceedingly valuable, and a useful invention.

On cross-examination the witness stated, that he was an engineer by profession—that he had never known wire applied to rope, or heard of the invention antecedent to the plaintiff's patent. The counsel for the defendant having drawn the attention of the witness to the manufacture of a toasting-fork, which was composed of twisted wire, he admitted that such an application was certainly not novel, but thought it distinct from a rope or rigging—had seen wire employed in many ways, but never as a rope until the plaintiff's patent. Witness described the specification, as understood by him, and expressed his belief that the meaning of the claim put forward by the patentee was that of embracing the manufacture of all metallic ropes, or combination of wires according to the specification, without reference to the metal of which such wire is composed.

Mr. Hindmarsh then put in admissions of the patents and specifications, and the fact that the defendant had infringed them, which were read, and closed the plaintiff's case — the learned counsel admitting that, from the absence of a witness, he had no evidence to show that the second patent had been infringed.

Mr. Corrie proceeded to address the jury on the merits of the case, and directed the attention of the learned judge to the legal and technical objections which he considered might be fairly brought forward, and which could not, in his opinion, have any other effect than that of obtaining a verdict for his client. The manufacture which the plaintiff claimed to himself was in reality no invention of a new manufacture, and the specification was nothing more than a general claim; indeed, on reference to the words in which the specification was summed up, it would be apparent to his Lordship that there were no grounds for the action whereon the plaintiff could claim a verdict. It had been shown that rods, or links, of iron had been previously used for standing rigging, or stays, on board of vessels, and he believed his Lordship and the Jury would be of opinion that the manufacture was by no means novel or deserving of that protection contemplated and acquired under the statute of James. Again, supposing for a moment that it should be in the opinion of the court as coming under such statute, and was designated a manufacture, he should then contend that such manufacture was not novel, inasmuch that he had an illustration sufficient for his purpose in the manufacture of a toasting-fork, which, being composed of twisted wires, was, in fact, the same as the wire rope, or standing rigging —the material of which it was composed being the same.

The Presiding Judge (Baron Maule) here interrupted Mr. Corrie, by observing that it was a very different thing to toast bread on a toasting-fork, and to make a rope of wire—the idea seemed to him absurd.

Mr Corrie continued, by adverting to cases which had been determined, and on which he relied, as precedents in the present instance. The learned counsel admitted the usefulness and value of the invention, which, he observed, could not be controverted after the evidence afforded that day; but he contended there was no novelty in such invention to which the plaintiff could lay claim.

Mr Baron Maule having submitted to the counsel for the plaintiff that a question might be left with the Court to determine whether the invention or manufacture was a fit subject for a patent,

Mr. Hindmarsh preferred leaving the question to be decided by the Jury.

The learned Judge then summed up the evidence and observed that, if the question had been left with him, he should at once have declared the patent good.

On application made by the counsel for the defendant, leave was given to move for a nonsuit on one of the counts, and with such reservation, the Jury *found a verdict for the plaintiff.*

The Judge expressed his readiness to certify for costs.

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### *Smith* v. *Watson.*

This was a second action between the same parties, as in the former case, involving the merits of a further patent taken out by the plaintiff in the year 1839, for the manufacture of wire rope, in a form and manner dissimilar from the two patents of 1835 and 1836, being a twisted rope formed of strands as in the manufacture of hempen rope, the only difference being in the material. The address of the learned counsel for the plaintiff was a mere echo of his speech on the first action, and the evidence generally throughout was a mere repetition or confirmation of that previously given, the only difference being, that the evidence here given related to the merits of the wire rope, and not to that of standing rigging or salvagee rope.

Mr. Mayes, a rigger, employed on the Blackwall Railway, deposed that in the course of his duties he had laid down sixteen miles of hempen rope on the railway when first opened, the circumference of which was from 5½ inches to 7½ inches. The wire rope of the plaintiff had been applied on the railway upwards of twelve months since; the carriages on the line were drawn by a length of rope which was drawn or wound over a drum by means of stationary engines at the termini. Witness had never heard of any wire rope until he became acquainted with that of the plaintiff's. The wire rope had been found to answer the purpose, and the consequence was that the use of hempen rope had been discontinued, and the whole of the line was now worked

by wire rope. Had tested the strength of wire rope of four inches circumference with various specimens of hempen rope, varying in size from 5¼ inches to 7½ inches, and found the former to be of greater strength than the latter. Had never known the plaintiff's rope to break, although the swivels and splicings had in some instances given way. The hempen rope, when in use, was subject to continued breakages, having known the rope to break two or three times in one day. Witness considered the invention as useful, and more economical, from there being less wear and tear, as also from its being of smaller circumference, and less weight.

Mr. Woods, engineer of the Liverpool and Manchester Railway, disposed to the plaintiff's wire rope being used in the tunnel at the Liverpool terminus. It was found to answer the purpose, but not having been at work any considerable length of time he could not undertake to draw a comparison between it and hemp. The size of the rope was ¾-inch diameter, or 2¼-in. circumference; the hempen rope which had been previously used was a 4½-inch; the rope worked over a drum of 3 feet diameter.

Mr. Leslie, the manager of the Anderton Carrying Company, had applied the wire rope of the plaintiff to raising weights, and also on an inclined plane. He was formerly prejudiced against it, but since he had tested its properties he had arrived at the conclusion that it was an invaluable invention, and of great benefit to the community.

Mr. Corrie, on the part of the defendant put in, as evidence, the drawing which accompanied the specification of the patent of 1836, to which he directed the attention of the jury, the learned counsel contending that the twisted wire rope was comprehended in that patent, and, therefore, could not be claimed under the patent of 1839. To illustrate this view of the case, he proceeded to remark on the similarity displayed in the patents of 1836 and 1839, as related to the twisting of the wire, it appearing, however, that in the former case the wire was simply entwined in forming a splice, while in the latter it was regularly laid in strands and formed as a hempen rope.

The learned Judge thought the jury could not do otherwise than give a verdict for the plaintiff, which was done accordingly.

[We have copied the reports of the two preceding cases from the *Mining Journal*, but have taken the liberty to omit some portions in which the reporter appears to have departed from the line of strict impartiality, which reporters of law proceedings ought invariably to observe. Indeed, we must confess, that when we couple the partizan character of these reports, as given by our contemporary, with certain strange rumours which are abroad respecting the *bonâ fide* character of the proceedings reported, we have our doubts whether we should not have done better to omit them altogether. Some of the evidence adduced for the plaintiff certainly is, on the face of it, of a most suspicious description. Take that of the witness Mayes, for example:—could no person of more authority than a common labourer be found to speak to the result of the trial made of the plaintiff's wire rope on the Blackwall Railway? Where was Mr. Bidder? Or Captain Routh? Mayes swears that the wire rope (meaning Smith's) has been found to "answer the purpose," and that the consequence has been "that the use of hempen rope has been discontinued, and *the whole line of road worked by wire rope*" (meaning Smith's wire rope). We question much whether Mr. Bidder or Captain Routh, or any other respectable gentleman connected with the line, would have sworn as much. We have always understood that Smith's wire rope, so far from answering the purpose on this line had proved a failure, and that another sort of a much superior description, patented by Mr. Newall, had been substituted for it. If we have been misinformed on this point, we shall be glad to be set right by Mr. Smith, or any of his witnesses or friends.—Ed. M. M.]

## *The Queen* v. *Bynner*.

[THE SOLAR LAMP PATENT.]

We have already, (p. 48 of our present vol.) stated generally that the verdict in this case was for the Crown, whereby the patent has been annulled; but as it may be interesting to many of our readers to know more precisely the grounds for this decision, we now now give a verbal report of the charge of the Judge, (Coleridge) and finding of the Jury, as they are reported in a very long and special account of the trial which appears in the *Birmingham Gazette* of the 15th inst.

"The Learned Judge after explaining to the Jury the law as applicable to this case, very distinctly analyzed the whole of the evidence, presenting to their consideration each particular point insisted upon by the prosecution contrasted with the counter-evidence, whereby the defendant endeavoured to refute the same, and, after going through the whole of the case with great clearness and care, which occupied his Lordship about three hours, left the following points for the consideration of the Jury:—Whether a precise size of aperture in the deflector and height above the flame were essential to produce the effect?—Whether the specification, aided by the drawings, sufficiently described such size and height?—Whether the peculiar chimney described as essential to produce the fullest effect was beneficial? And whether the invention could be used with "ordinary chimneys of glass?"—Whether the invention was new? And whether Mr. Bynner was the inventor?

After a very short deliberation the Jury returned into Court, and the Foreman stated that they were unanimous in finding that a precise size of aperture and height above the flame were essential to produce the effect; that the specification aided by the drawings did not sufficiently describe such size and height; that the peculiar chimney was of no use at all; that the invention could not be practically used with ordinary chimneys of glass; that the invention was not new; and that Mr. Bynner was not the inventor.

This finding of the Jury entitled the Crown to a verdict upon the first, second, third, fourth, fifth, sixth, and eighth issues; the seventh, which was only as to whether the pretended invention was a manufacture within the statute of James the First, was, by consent given for the defendant.

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*American Enterprise—Canal-Steam-boats.*—On a visit to Bordentown, we saw two new steam-boats that had just arrived there through the Delaware and Raritan canal, from New York, where they were built, being on their way to this city. The boats are built of iron, and moved by Ericsson's paddle-wheel propeller, which will be wholly under the surface of the water when they are loaded. Each boat is furnished with two of those wheels, which work under the stern—one on either side of the rudder. Besides having an engine, the boats are schooner-rigged, in the most beautiful symmetrical manner of any thing of the kind we have ever beheld. The length of the boat is 97 feet 4 inches; breadth of beam, 23 feet; depth of hold, 7 feet 6 inches. Their capacity is equal to two hundred and thirty tons of coal. In the Raritan river, the speed of these boats was nearly ten miles per hour. In the canal, six miles the hour. We consider that the acme of canal navigation has now been reached, by the performance of these boats.—*Phil. Eve. Journal.*

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# Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 994.] SATURDAY, AUGUST 27, 1842. [Price 6d.

Edited, Printed and Published by J. C. Robertson, No 166, Fleet street. Double.


## ROWLEY'S ROTARY STEAM-ENGINE.

Fig. 1.

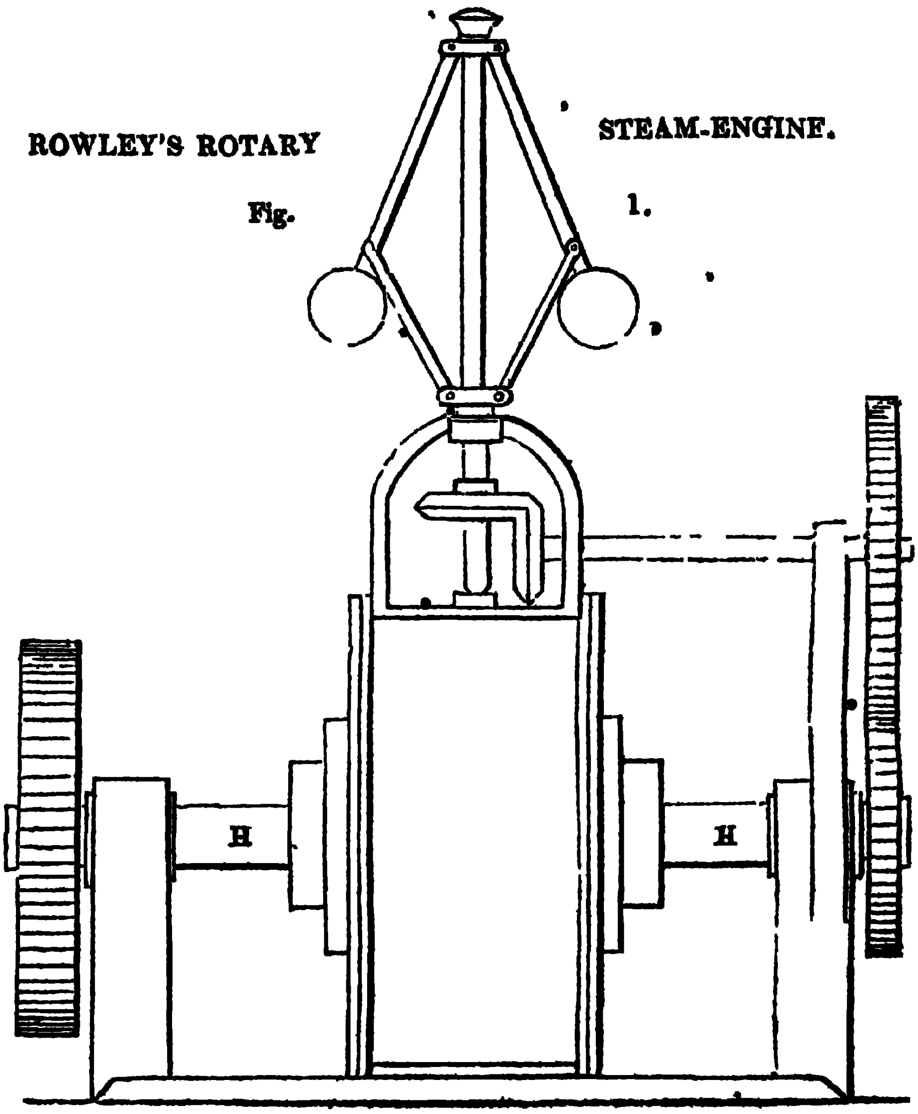



Fig. 2.

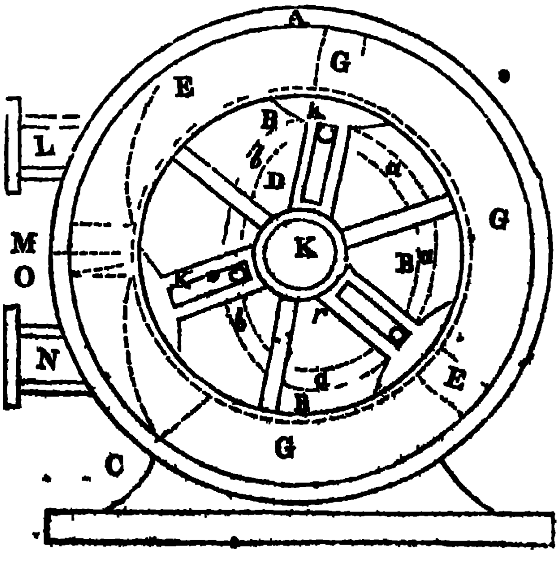
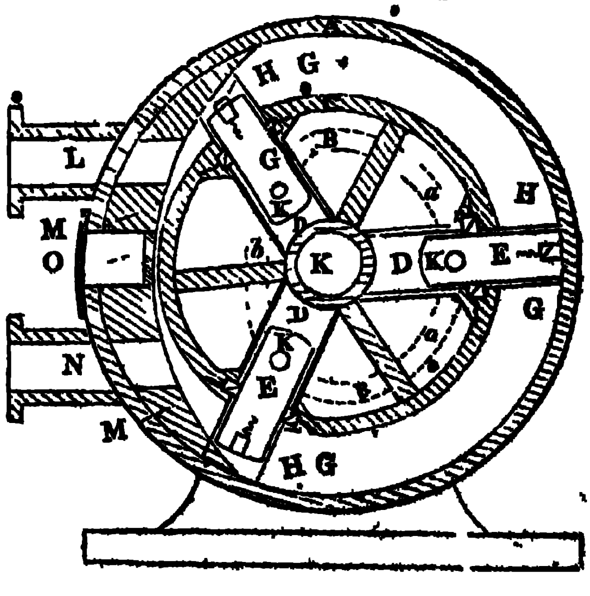



Fig. 3.



## ROWLEY'S ROTARY STEAM-ENGINE.

Manchester, 14, Upper Brook-street,
August 2, 1842.

Sir,—The little success which has hitherto attended rotary steam-engines has caused most people to be sceptical as to their ever being able to compete in efficiency, economy, and durability, with reciprocating ones. Influenced by this, I resolved not to publish any statements regarding the one patented by me, till it had worked for such a length of time as would enable me to speak confidently as to its performances.

I have now pleasure in forwarding you, for insertion in your very interesting publication, accounts of the stationary engine belonging to Messrs. R. Johnson and Brother; and also of a locomotive, on the same plan, which has been experimented with on the Liverpool Railway.

I have the honour to be, sir,
Your very obedient servant,
EDWARD BUTLER ROWLEY,
(Late R. N.)

### I. *The Stationary Engine.*

Diameter of steam-wheel, 36 inches; breadth of ditto, 14½ inches; depth of ditto, 4 inches; mean length of steam chamber, 100 inches; pistons or slides, 58 square inches, subjected to the action of steam; number of revolutions, 80 per minute; with 1 lb. pressure ungeared, or with less than 5 lbs. driving shafting. It stands on a bed-plate, 5 feet by 4, and is 3½ feet high.

By reference to the figures 1, 2, and 3, it will be seen that the engine is composed of an outer ring, or cylinder, A A A, and two side plates, exactly alike, having on their inner side an endless groove, B B B, formed of a segment of a circle; *a a a*, and a portion of an irregular curve, *b b b*. There is a circular wheel or apparatus, C C C, having three chambers, D D D, in it, for the reception of the pistons E E E, and for allowing the same to slide in and out. This wheel has two flanches, G G G, having grooves in them, H H, for the support of the pistons, and is firmly keyed on the central shaft F F, which passes through the side plates, and revolves in suitable bearings. The guide-pins of the pistons, K K K, travel in the endless groove B B B, on the inner side of the side plates.

Thus it will be seen, that, as the expansive power of the steam, introduced through the inlet pipe L, exerts itself against the pistons, it will cause the wheel C C to revolve; and as the guide-pins of the pistons travel in the endless groove B B, the pistons will be alternately drawn towards the centre of the wheel, to enable them to pass the abutment M M, and then be again projected into the steam-chamber; after the steam has exerted its force against the pistons, it will escape by the exit-pipe N. O O denotes the chamber for metallic abutment packings.

The engine is employed in turning wire, or rather ripping blocks; and as the force which is exerted is constantly varying, (the mercurial gauge attached to the cylinder ranging from 5 lbs. to 25 lbs.) it is difficult to estimate the horse power actually used.

To calculate the power, multiply the number of square inches on the piston, 58, by the pressure, 30 lbs., and that by mean length of steam chamber, 8·4 feet, which multiply by number of revolutions per minute, 80; then dividing by 33·000 will give the horse power.

Thus, $58 \times 30 \times 8{\cdot}4 \times 80 \div 33{\cdot}000 = 35{\cdot}4$ horse power.

Messrs. R. Johnson and Brother have permitted the publishing of the following letters.

"Wire Mill, 27, Dale-street, Manchester,
"August 14, 1842.

"Mr. E. B. Rowley.

"Sir,—We have great pleasure in stating that we are perfectly satisfied with the regularity of working of the rotary steam-engine. The consumption of fuel, and time worked during the five weeks ending July 29th last, are as follows—338 hours time, and 48 tons 10 cwt. of coal. The engine has been at work on our premises for the last seventeen months.

"We are, &c. &c."

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"This is to certify, that I have had the management of Mr. Rowley's Patent Rotary Engine for the last eleven months, and testify that it works remarkably well and powerfully. The engine has been lately examined, and found in excellent condition.

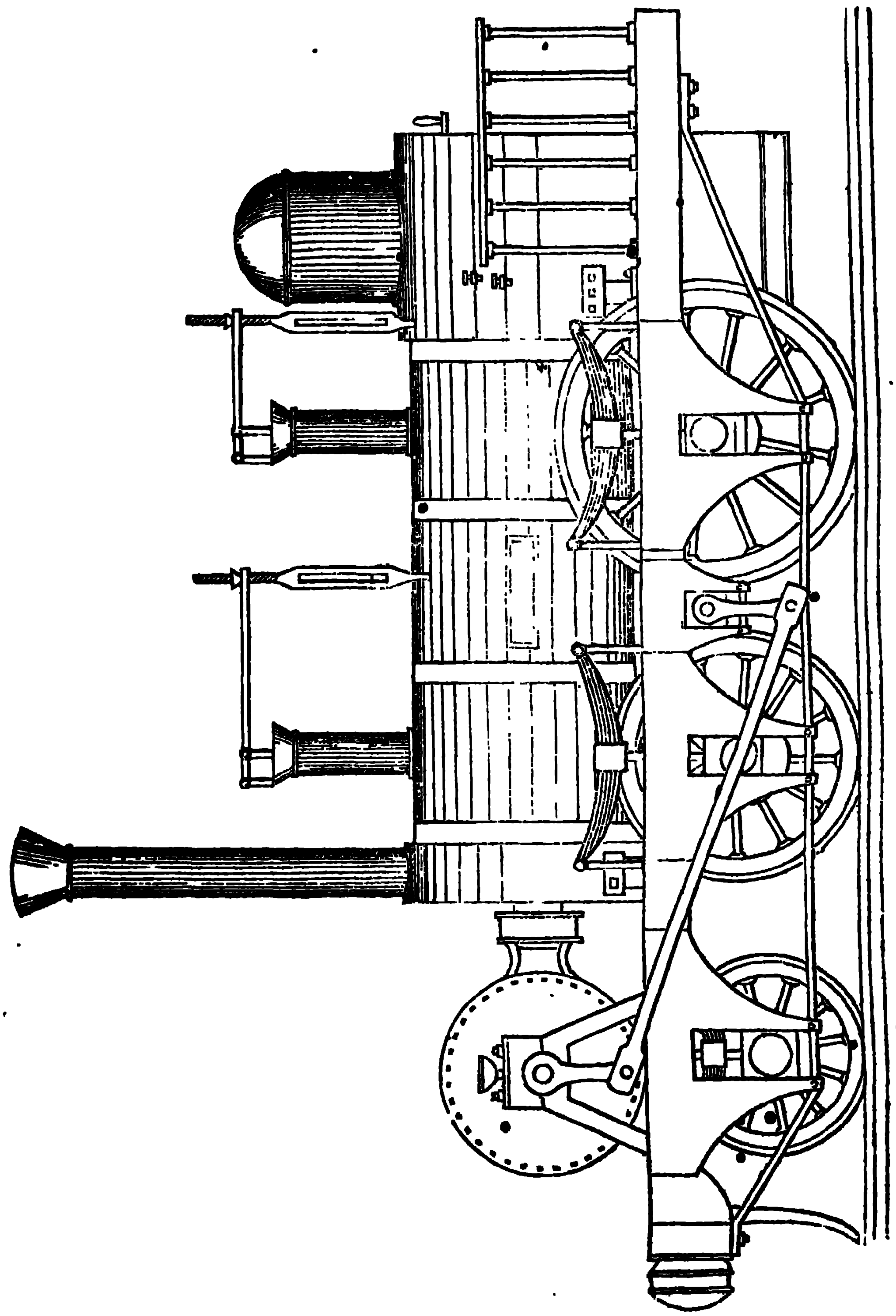
"WILLIAM AMPHLETT, Engineer,
"At Messrs. R. Johnson and Brother."
"August 5, 1842."

### II. *The Rotary Locomotive.*

The best method of arrangement must be decided by experiment. I am at pre-

sent inclined to give the preference to the plan as presented in fig. 4, where the connexion between the engine and driving-wheel is effected by means of double

Fig. 4.



cranks, and an intermediate shaft having a spur-wheel on its centre, which works in a pinion on the driving axle. The advantages that will result from this are,

that the same engine may be adapted for a passenger or luggage train; or, in other words, can be made equal to a 11 or 18 inch cylinder, by proportioning the spur gearing. There will also be an entire absence of any sinuous or oscillatory motion, which is a fruitful source of danger, is highly destructive to the tires of the wheels, and has a constant tendency to disturb and damage the rails.

The experimental locomotive recently tried on the Liverpool line was driven by spur-gearing on the centre of the driving-axle, but differently arranged from the plan now proposed. As respects its friction, it was found that with 2 lbs. pressure in the boiler, when the driving-wheels were supported, it would make 80 or 100 revolutions per minute, and that with 10 lbs. it would move itself and tender on the rails. The highest velocity obtained was 37 miles per hour.

The following are the results of some of the experiments, though I must premise, that the boiler used was an old and inefficient one. The dimensions of its heating surfaces are 37·84 square feet, exposed to radiant caloric; 258·44 feet are of tube surface; length of ditto, 6 feet 6 inches.

| Date. | Load. t. | cwt. | qrs. | Aver. speed in miles per hour. | Distance run in miles. |
|---|---|---|---|---|---|
| June 15 | 59 | 12 | 2 | 17 | 11 |
| " 18 | 57 | 11 | 0 | 18 | 30 |
| " 30 | 45 | 0 | 0 | 19·3 | 30 |
| July 1 | 22 | 0 | 0 | 25 | 14 |

As an accurate account of the consumption of coke had not been kept, a trip was made to ascertain this: the following are the particulars, as furnished by Professor Phillips, of the New College, Manchester.

"Manchester, Monday, July 18, 1842.

"Dear Sir,—I enclose the following account of the experiment made with the *Mars* rotary locomotive engine, on Saturday last, to determine the consumption of fuel. I should first state that the boiler was so imperfect and leaky, that we dared not put any pressure on, so that the actual power and velocity of the engine with its load could not be fairly tested. All the tubes were leaky, and several plugged.

"At the mean pressure of 40¼ lbs. per square inch in the boiler, the engine would have consumed 514½ gallons of water during the experiment; whereas the quantity actually employed was 617½ gallons, by actual measurement of the water in the tender, at starting and at stopping. From the leaky state of the boiler, and from an imperfection in the reversing valve, which was not tight, one-fifth of the whole quantity of steam generated was wasted. The water was nearly cold in the tender at starting. I think the result of the experiment very fair, upon the whole; and I feel satisfied that, with an efficient boiler, the engine will be found both economical and effective. One of its great advantages is, that there is no *lateral* motion. As I have made many trips with the engine, I can state that the sinuous motion which takes place in the ordinary form of the locomotives in use does not happen with your engine, thus rendering it less likely to run off or injure the rails. The pressure of the steam in the boiler was ascertained by a thermometer, and also by two safety-valves, with the usual spring balance. I took the pressure at the end of every mile.

"Yours very truly,

"MONTAGUE L. PHILLIPS."

"To Mr. E. B. Rowley."

*Mars* rotary locomotive, with tender, = 20 tons, left Liverpool for Manchester, with 12 loaded wagons = 60 tons, 1 cwt. 3 qrs.; gross load = 80 tons, 1 cwt. 2 qrs., at 1 h. 42 min. Strong wind ahead.

| Miles. | Hours. | Min. | Sec. | Pressure in Boiler. | |
|---|---|---|---|---|---|
| 1 | 1 | .. | .. | 46 | |
| 2 | .. | .. | .. | .. | |
| 3 | .. | 53 | 50 | 38 | |
| 4 | .. | 57 | 20 | 30 | |
| 5 | 2 | .. | 35 | 47 | |
| 6 | .. | 4 | 55 | 31 | |
| 7 | .. | 7 | 30 | 53 | Sutton incline |
| 8 | .. | 14 | 31 | 41 | |
| 9 | .. | 18 | 20 | 56 | |
| 10 | .. | 22 | 15 | 33 | |
| 11 | .. | 25 | 30 | 44 | |
| 12 | .. | 27 | 45 | 38 | |
| 13 | .. | .. | .. | .. | |
| 14 | .. | 35 | 45 | 48 | |
| 15 | .. | 37 | .. | 38 | |
| 16 | 2 | 40 | 25 | 41 | |
| 17 | .. | 43 | 30 | 31 | |
| 18 | .. | 46 | 40 | 36 | |
| 19 | .. | 50 | .. | 38 | |
| 20 | .. | 52 | 50 | 44 | |
| 21 | .. | 55 | 45 | 38 | |
| 22 | .. | 59 | 5 | 36 | |
| 23 | 3 | 3 | 30 | 54 | |
| 24 | .. | 7 | 10 | 41 | |
| 25 | .. | 12 | .. | 50 | |
| 26 | .. | 16 | .. | 42 | |
| 27 | .. | 20 | 25 | 47 | |
| 28 | .. | 24 | 30 | 34 | |
| 29 | .. | 29 | 15 | 33 | |
| 30 | .. | 33 | .. | 23 | |

Average pressure of steam in boiler, 40½ lbs.

Average velocity in miles per hour, 16·2·

Consumption of fuel, 4 bags of coke = 560 lbs., and 2 bags of coal = 280 lbs., which I consider equal to 187 lbs. of coke, which will give 24·9 lbs. of coke per mile.

### PROBLEM IN TRIGONOMETRY.

Sir,—I am rather late in enrolling myself as a contributor to your very useful and widely circulated miscellany; but papers of an interesting and novel character having accumulated on my hands, I hope that you will, from time to time, allow me a small space in your columns, in order that I may communicate their contents to the public. Some of those papers are of a very abstruse and startling nature, and may probably excite some curiosity in the minds of many of your readers; others are of a nature purely practical, and will be read with interest by those who are engaged in mechanical pursuits.

As my name is already well known in connexion with mathematical and mechanical subjects, I feel inclined to have it suppressed in all my communications, and propose to pass *incognito,* under the anagrammatical designation of

Your friend and Servant,

UNIT STUART.

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There is a problem in Trigonometry of very great use to maritime surveyors, in fixing the position of rocks, shoals, and other dangerous obstructions to navigation. This problem has been very often proposed for solution, and as often resolved, but there is still wanting a practical rule that will apply to all the cases, without requiring a separate investigation of a different construction for each.

In one of the early numbers of Mr. Colburn's United Service Journal, I gave an analytical solution of all the cases, deduced from a valuable but neglected theorem in Emerson's Trigonometry. This solution, with slight variations, was shortly afterwards copied into the third volume of Dr. Hutton's Mathematical Course, but without any acknowledgment of the source from which it had been obtained.

The several equations arising from the solution here alluded to have all more or less of a resemblance to one another, and contain some common terms; but they are not so closely identified in form as to admit of enunciation under one general rule. This is what is wanted, and it is for this purpose that the problem is re-proposed.

#### PROBLEM.

*Given the distance between two objects* A *and* B, *with the angles observed at the stations* C *and* D, (*all in the same plane,*) *to find the position of the stations.*

My attention was first directed to the subject by Captain John Hobbes of the Royal Engineers; while he was superintending the grand trigonometrical survey of Ayrshire, in the West of Scotland. The solution I then gave was purely geometrical: but it was considered by the proposer, and other mathematicians in that part of the country, as being a very comprehensive and elegant one, and gave occasion for much discussion amongst those who were capable of appreciating its beauties. It is not unlikely that a republication of the problem, may elicit an answer from some of those who remember the circumstance, although a period of more than twenty years has clapsed since it was first agitated amongst them.

U. S.

August 19, 1842.

### TRANSMISSION OF GALVANIC ELECTRICITY—MESSRS. WRIGHT AND BAIN'S EXPERIMENTS.

Sir,—In your Magazine of the 23rd ult., is a letter signed "C. W." in which the writer has called attention to some successful experiments made at Calais in 1803, by passing galvanic electricity, when using water as part of the electric circuit, in order to show that Mr. Bain and myself were not the original discoverers of the two or three facts you mentioned, as having witnessed at the Serpentine river. Neither Mr. Bain nor myself were aware of similar experiments having been tried by Aldini until we saw "C. W.'s." letter; but, if we had been, they were not exactly analogous to ours, as it appears he used a "*pile of eighty plates,*" which would produce an electri-

city of high tension, more resembling the electricity of the atmosphere (or lightning,) than the *voltaic current* used by us, (generated by a single cell, containing two inches of platinum, and one of zink.) "C. W." will see that the two experiments bear little resemblance to each other, as the electricity employed at Calais, from its nature, would be expected to travel through feeble conductors, such as water, or moist earth, (and this it was which enabled Aldini to give *shocks*.) Now it is well known that this electricity would not answer the purpose of a telegraph; neither would voltaic electricity give shocks, not being sufficiently intense to pass through the body. Supposing we had gone no further than merely to dip the ends of the metallic conductors into the water, we should not have succeeded in passing the current from our battery, for we found that a considerable surface of metal was necessary, at the ends, to convey the electricity to and from the water; this we supplied by fastening a coil containing 40 or 50 yards of wire to the ends of the metallic conductors, immersed in the water. With respect to the bare wires laid through the Serpentine, we did not "try the current with the wires above the water," as this would have been a difficult operation; but we tried the power of the current at several points between the banks of the river, with the bare wires immersed, and found that when a *powerful* battery was employed, a very considerable portion of the electricity passed from the positive to the negative wire without going to the opposite bank, and this was particularly the case within the first fifty or sixty yards of the battery. With the small battery, however, used in the first experiment, nearly the whole current was confined to the wires and passed through their whole extent, from bank to bank of the river. But a curious and unexpected result took place, namely, when the wires were removed from the battery the magnetism did not immediately cease, as in a dry circuit, but gradually *died away*. This, when first observed, appeared an insurmountable obstacle to the working a telegraph through water; but it occurred to us to *reverse* the current, which had the effect of immediately annihilating the magnetism, and inducing it in the opposite direction, and as often as this was repeated the same result followed. By these means we can give signals nearly as quick as with the wires insulated, and we still think that by using conductors of sufficient capacity, the current can be sent a sufficient distance for ordinary telegraphs; for, although all the electric currents would not reach the extreme ends of the line, still there would be sufficient to reflect the electric conductor: for we find this can be done by a tithe of the power necessary to move the needle, or produce magnetism in soft iron.

Can "C. W." or any other of your correspondents oblige Mr. Bain and myself by giving an explanation of the magnetism not ceasing, upon the current being broken when the wires were immersed in the water? For, time and other circumstances prevented our carrying the investigation so far as we wished.

I am, Sir,
Your obedient servant,
THOMAS WRIGHT.

August 15, 1842.

## THE NEW STEAMER, "QUEEN."

Sir,—Having read in your valuable Magazine the report of the trial of a new steamer called the *Queen*, you will much oblige one of your constant readers by inserting the following remarks upon the report and the steamers in question.

I agree most cordially with that portion of your correspondent "L. P.'s" letter wherein he states that your publication is almost the only medium through which works of art or merit can reach the public; or, to use "L. P.'s" words, "the scientific world;" this is sufficiently known, and we are quite aware that some of the flying wonders of the present age of steam have been introduced to the public, and the scientific world through your very excellent medium. Very recently we had a very bold announcement of the extraordinary performance of the new phenomenon, the *Atmospheric* steamer beating the *Railway*, and making the quickest passage known between two given points; but, according to your correspondent "L.P.," it has been reserved for another new prodigy, the *Queen*, to outstrip all former productions and compeers, and again to beat the poor *Railway*, and not only beat but cruelly to tantalize her,—just as a cat with its victim mouse first lets it run a given distance, and then overtakes it for very sport. We may therefore shortly

expect that the feats of the celebrated Flying Childers, and the trip of Mr. Green to Wielberg to breakfast, will shortly be remembered as feats remarkable only for the dark ages in which they were performed.

Let us just take something like a fair glance at the performance of the *Queen* steamer—regarding the probable as well as the possible. That she is excellent I do not deny—nothing less could be looked for from the able hands who have turned her out; but when a scientific description of any new scientific production is given to the public, it should be fully and impartially given—nought "set down in malice," nor "aught extenuated"—I think "L. P." admits that the victory was in *in some measure* to be attributed to the number of passengers the *Railway* carried at the time; but he gives no size or quantity of this measure which obtained for the *Queen* the victory. Rather might "L. P." have said, that as the Lords Commissioners of the Admiralty could find no measure of praise sufficiently large for the *Queen*, neither could he find any measure of right dimensions to account for the *Railway's* defeat, nor any comparative measure between carrying a load and no load. There, is however, I think, another measure, if it could be correctly ascertained, to which a share of the *Queen's* victory might in some degree be attributed; it is this—the very nice and excellent condition in which the *Queen* would be prepared for the occasion of an experimental trip with Her Majesty's Commissioners of the Admiralty on board, in comparison with a boat of a public company making three or four trips daily between London and Gravesend for hire, and not being allowed to stop for any adjustment. The improbability of a boat of this description being in first-rate order is sufficiently apparent.

On Tuesday last the *Queen* fell in with another of the steamers belonging to the Railway Company (the *Blackwall*), the result of which passage has left her steam majesty no room at the top of the list. The *Blackwall* followed the *Queen* from Blackwall, and, notwithstanding her being freighted with 160 to 170 passengers, and making one stoppage, gained from 3 to 4 minutes upon the *Queen* (which never stopped) to Gravesend.

I think, Sir, all candid readers and lovers of fair play will agree with me in the conclusion that it cannot be a result upon which the public can fully rely, when a boat is brought out in prime racing condition, and challenging unprepared the over-worked boats on trials of speed. Either let them be both loaded or both empty, both healthy or both diseased, and the expense in fuel for each accurately taken, so that the public may see the real and true merit of the competitors. This would render justice to each and prevent the interested friends of parties from misleading the steam-boat patrons and the public at large.

I remain, Sir,
Your most obedient Servant,
VERITAS.

August 17, 1842.

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THE BLACKWALL RAILWAIY AND MESSRS. NEWALL AND CO.'S WIRE ROPE.

Sir,—We have seen your remarks in No. 993, as to our patent wire rope, used on the Blackwall Railway, and beg to say that you have been misinformed, if you mean it to be understood that we have supplied that Company with a full set of ropes. We have supplied them with several miles in addition to what they had of ours at work this time last year, and beg to refer your readers to Mr. Stephenson's opinion of our "improved wire rope," as given in the *Railway Times* of 5th March last, in the Report of the Blackwall Railway Company's meeting.

We are, your obedient Servants,
R. S. NEWALL & Co.

Gateshead, August 22, 1812.

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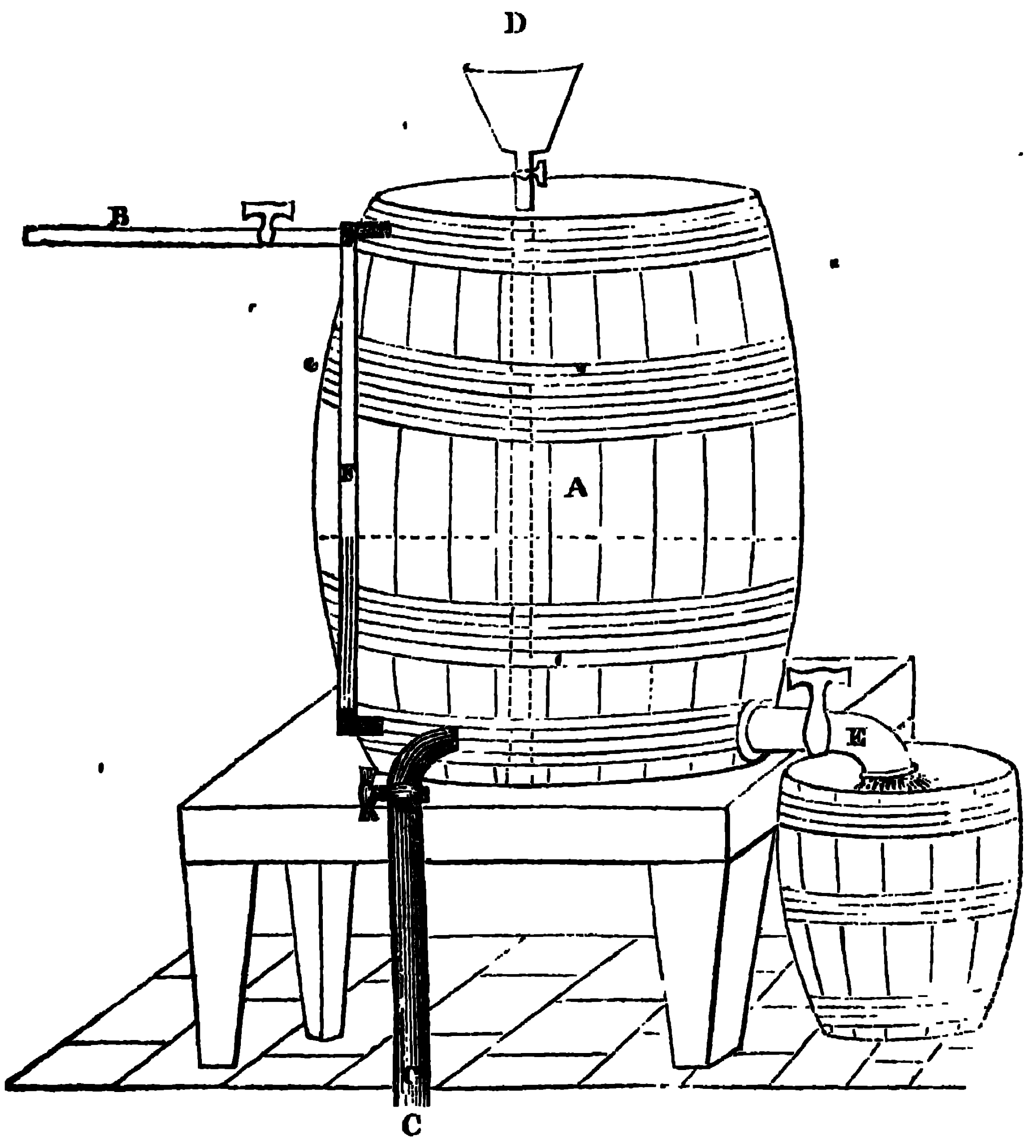
SMITH'S WIRE ROPE.

Sir,—The only answer I think it necessary to give to your remarks on the late trials at Liverpool in vindication of my patent for wire rope, is, that I am using all possible expedition to bring Mr. Newall and the Blackwall Railway Company, and many other infringers of my patent before the same tribunals, when they shall have an opportunity of answering for themselves. Mr. Newall has got service of our proceedings already; and it will not be the first time if the Blackwall Railway Company, *after setting me at defiance, come the day before trial, and submit without showing themselves in Court.*

I am, Sir, your obedient Servant,
ANDREW SMITH.

2, White Lion Court, Cornhill,
August 25, 1842.

THE JERSEY ATMOSPHERIC PUMPING ENGINE.




Sir,—I send herewith a sketch of an apparatus, which I call my atmospheric engine, which I have had in use in a dye-house for above twelve months, and have found very useful in raising water.* Simple in its construction, and effective in its operation, I anticipate its general introduction where pumps are now in use, as all labour and expensive machinery, wear and tear, are saved by its adoption. I will only add, that in situations where much water is required, this engine will be invaluable, and admirably adapted for use in steam-vessels.

A is a large wooden reservoir, in the form of a wine pipe; and, as great pressure is exerted upon its surface by the atmosphere, the head or top is sustained by a perpendicular post from the bottom, in the centre, as represented by the dotted lines.

B. A steam-pipe, conveying steam into the upper part of the reservoir.

C. A supply-pipe from the well, about 2 inches diameter.

D. A funnel to hold about two quarts

* Our correspondent points out, in a private note, that there is a resemblance between his atmospheric engine and that described in our last volume, page 443, as invented by Pierre Ravard, of Paris; but assures us that he had his apparatus in actual use long before the date of our description of Ravard's machine, and asks us whether it be not possible—seeing the Jersey papers contained some early notices of his invention—that Ravard may have borrowed from him? It is possible enough that this may have been the case; but equally so that both may have been independent inventions. However the question of priority of invention may stand, there can be no doubt as to the great simplicity and utility of the apparatus itself.—Ed. M. M.

of cold water, with a stop-cock, for condensing the steam.

E. A large tap to draw off the water raised.

F. A glass tube communicating with the upper and lower parts of the reservoir, showing the level of water in the reservoir.

To raise the water, I proceed as follows:—

I first, by opening the pipe B, fill the reservoir with steam, which may be ascertained by its forcing its way out at the tap E, driving the atmospheric air before it. I then close both B and E, and open the tap of the funnel, to allow a portion of the cold water it contains to flow into the reservoir, which condenses the steam, and thereby causes a partial vacuum, which tap must be closed before the funnel is quite empty, to prevent any air finding its way into the interior. The supply-pipe C is now opened, when the water instantly rushes up, and fills the reservoir in an incredibly short space of time.

The steam-pipe may be made use of to force the contents of the reservoir out through the pipe E, which it will do very advantageously; and as no air will then be admitted, the apparatus is in its best state for a second operation; and so on, *ad infinitum.*

I remain, Sir, yours respectfully,
JAMES SCHOLEFIELD.

4, Grenville-street, St. Helen's, Jersey.
August 4, 1842.

## THE ROYAL STEAM NAVY.

We subjoin a set of Rules and Regulations which have just been issued by the Lords of the Admiralty, respecting "the examination, appointments, rank, pay, allowances, &c. of engineers in Her Majesty's service;" and, considering how many of our readers are personally interested in the subject matter of this document, and how much it concerns the nation at large, that due encouragement should be given to the new and all-important branch of our public service, to which it relates, we are sure no one will think the space which it occupies ill-appropriated, or quarrel with us, for further requesting attention to the few remarks which we feel called upon to make upon it.

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"The Lords Commissioners of the Admiralty, in order to insure the efficiency of the engineers employed in the war steam navy of this country, have from time to time issued rules to regulate their examination as to qualification for the trust reposed in them, and to keep pace with the improvements in steam navigation, and the great value of the vessels about to be constructed for the service, have revised and improved the regulations for the whole of that now important branch, and the new rules and regulations have just been issued, dated June 23, 1842, and are as follows:—

"RULES AND REGULATIONS RESPECTING THE EXAMINATION, APPOINTMENTS, RANK, PAY, AND ALLOWANCES, ALLOTMENT, UNIFORM, AND SUPERANNUATION OF ENGINEERS IN HER MAJESTY'S SERVICE.

"EXAMINATION.

"No person will be deemed eligible for an appointment as engineer, or for promotion to the second or first class, until he shall have passed an examination on the points stated below, or on such other points as the Lords Commissioners of the Admiralty may from time to time think proper to require before the captain-superintendent of Her Majesty's dockyard at Woolwich, and the chief engineer and inspector of machinery, or before such other officers as their Lordships may appoint for that purpose.

"Before presenting himself, the candidate must prepare specimens of working sketches, and of his proficiency in accounts.

"First-class Engineers.—No person will be considered qualified to hold the warrant of first-class engineer who is not able to keep accounts, and to make notes in the log of every particular of the working of the engines and boilers.

"He must be thoroughly acquainted with the working of the principles on which the machine works in all its parts, capable of working the engines and boilers, and of setting right any defects which may arise in them, and of adjusting the length of the various rods and motions, slide-valves, eccentrics, &c.

"He must also be able to make rough sketches, with the requisite dimensions fit to work from, of every part of an engine, and be willing to take charge of the engineers' boys.

"Second-class engineers must not be inferior in education to those of the first class, and but little inferior to them in mechanical acquirements, and must also be willing to take charge of and teach the engineers' boys.

"Third class engineers must be equal in education to the section and first class engineers, and acquainted with the principles of

marine engines and boilers, and with the names and uses of all their parts. They must also be able to make rough sketches as before described.

"Those who have not served in Her Majesty's navy as engineers' boys, must be examined by the surgeon of the establishment as to their being of sound bodily constitution, and they must produce well authenticated certificates from the engineers in whose factories they have worked, of their being skilful workmen, of good disposition, and of good conduct in every particular, especially as regards sobriety.

"APPOINTMENT.

"Engineers are appointed by warrant from the Lords Commissioners of the Admiralty, or by commanders-in-chief on foreign stations, in vacancies occasioned by death in the same manner as other warrant officers of the navy are appointed.

"No person will be considered eligible for a second class engineer without having served at sea as an engineer, nor the first class without having served as chief engineer of a sea-going steam-vessel. In either case the candidate must produce satisfactory testimonials of his efficiency and good conduct while thus serving at sea.

"An engineer, after having served three years in the third class, will be permitted, if he can produce good certificates from the commanders under whom he may have served, to present himself in examination for the second class, when a suitable opportunity shall offer, and, in like manner, after having served three years in the second class, he will be permitted to present himself for examination for the first class. If, however, on examination it shall appear to the examining officers that the qualifications of a candidate are such that a shorter period than three years may be sufficient to enable him to acquire the experience necessary for performing the duties of a higher class, a note thereof, with the reasons, will be made upon the passing certificate, which will render him eligible for examination and promotion in less than three years, if his subsequent conduct should appear to merit it.

"RANK.

"Engineers are distributed into three classes; they rank next below carpenters, and with each other according to their standing on the official list.

"PAY AND ALLOWANCES.

"To engineers when serving on board one of Her Majesty's steam-vessels in commission; or in any of Her Majesty's dockyards, whenever their services may be required there; or in repairing their own or any other vessel in the home dockyards—Holyhead, the River Thames, Portsmouth, or Plymouth-harbour, or when the vessel to which they belong is paid off and they are still retained on board :—

"First class, 12*l.* per lunar month; second class, 8*l.* per lunar month; third class, 5*l.* 6*s.* per lunar month.

"When borne on the books of the guard-ships of the ordinary, and not actually employed in the charge or repair of steam machinery.—First class, 7*l.* 17*s.* per month; second glass, 4*l.* 18*s.* per month; third class, 3*l.* 8*s.* per month.

"The first class engineer of ships in commission is to have the instruction of two engineers' boys, and to receive an allowance of 6*d.* per day for each.

"When there are three engineers' boys, the second class engineer is to instruct the junior boy of the three, and to receive the allowance of 6*d.* per day.

"When there are four engineers' boys the senior second class engineer is to instruct the third boy; the junior second class engineer the fourth boy; and each is respectively to receive the allowance of 6*d.* per day for the instruction of the boy placed under him.

"This allowance is to be granted only on the production of a certificate from the commanding officer under whose orders the engineers may be actually serving, that the boys have been duly instructed in conformity with the established regulations, and such certificate is never to be granted unless the superintendent of the dockyard, or the officer in command of the vessel be thoroughly satisfied from personal observation that the intentions of these regulations have been strictly carried into effect.

"Engineers when serving on board one of Her Majesty's steam-vessels within the tropics, while the steam is up, are to receive one-half the amount of the pay of the respective classes in addition, for which they may draw every six months whether they allot or not.

"When engineers do not draw for their tropical pay, a certificate is to be granted to them, similar to that on the back of the bill for the adjustment of their claims to the said pay on their arrival in England.

"Engineers of vessels in commission, when employed in repairing defects of other vessels than those in which they are serving, except in the home dockyards, Holyhead, the River Thames, Portsmouth, or Plymouth harbour, to be allowed extra pay as warrant officers in addition, according to the scale established by Her Majesty's regulations—namely, 2*s.* a-day.

"ALLOTMENTS AND MONTHLY ALLOWANCE.

"The following are the scales of allotments and monthly allowance for engineers

while actively employed and while employed in guard ships :—

"ALLOTMENT WHILE ACTIVELY EMPLOYED.

| | £. | s. | d. |
|---|---|---|---|
| First engineer, per calendar month | 6 | 10 | 0 |
| Second engineer, ditto ........ | 4 | 6 | 0 |
| Third engineer, ditto .......... | 2 | 17 | 0 |

"ALLOTMENT WHILE IN GUARD-SHIPS.

| | | | |
|---|---|---|---|
| First engineer, per calendar month | 4 | 5 | 0 |
| Second engineer, ditto ........ | 2 | 13 | 0 |
| Third engineer, ditto .......... | 1 | 16 | 0 |

"MONTHLY ALLOWANCE WHILE ACTIVELY EMPLOYED.

| | | | |
|---|---|---|---|
| First engineer, per calendar month | 3 | 10 | 0 |
| Second engineer, ditto ........ | 2 | 5 | 0 |
| Third engineer, ditto .......... | 1 | 10 | 0 |

"MONTHLY ALLOWANCE WHILE IN GUARD-SHIPS.

| | | | |
|---|---|---|---|
| First engineer, per calendar month | 2 | 10 | 0 |
| Second engineer, ditto ........ | 1 | 10 | 0 |
| Third engineer, ditto .......... | 1 | 0 | 0 |

"UNIFORM OF FIRST ENGINEERS.

"Coat.—Blue cloth, double breasted; buttons having a steam-engine, with a crown above, embossed on them, to be placed four and four, and a larger button of the same kind on the collar.

"Waistcoat.—With buttons similar to those on the coat.

"Trousers.—Plain blue cloth.

"Cap.—With a narrow gold lace band.

"SUPERANNUATIONS AND PENSIONS.

"The following rules shall be observed in regard to superannuations and pensions of the engineers of Her Majesty's fleet:—

"First.—That when engineers shall be found upon survey unfit for further service they shall be allowed 3*l.* a-year for each year they shall have served as warrant-officers in ships in commission; and 1*l.* a year for each year they shall have served as warrant-officers in ships in ordinary, or as supernumeraries in guard ships.

"2nd.—That in cases in which the services of engineers shall appear to the Lords Commissioners of the Admiralty to be more than ordinarily meritorious, a further sum may be allowed to the said warrant-officers in addition to the pension allowed by art. 1, varying from 1*l.* to 15*l.* a-year, reference being had to the character of the officer, and the cause which may have rendered him unfit for service.

"3rd.—1, that engineers who may lose two limbs in action; 2, or who may receive wounds or injuries in action equal to the loss of two limbs; 3, or who may receive injuries or hurts in the service, though not in action, equal to the loss of two limbs, shall be allowed pensions (as the Lords Commissioners of the Admiralty may deem proper), not exceeding in the first case 50*l.* a-year, nor in the second case 45*l.* a-year, nor in the third case exceeding 35*l.* a-year.

"4th.—1, that engineers who may lose one limb in action; 2, or who may receive wounds or injuries equal to the loss of a limb; 3, or who may receive injuries or hurts in the service, though not in action, equal to the loss of a limb, shall be allowed pensions (as the Lords Commissioners of the Admiralty may deem proper), not exceeding in the first case 25*l.* a-year, nor in the second case exceeding 20*l.* a-year, nor in the third case exceeding 15*l.* a-year.

"The pensions for wounds and hurts to be granted after a careful survey, held by the officer at this office, when practicable, and to be in addition to any other pension the officer may be entitled to.

"5th. No engineer to be allowed to reckon as service towards superannuation any period of time during which he shall not have maintained a good character in the ship in which he has served.

"REGULATIONS AS TO THE INSTRUCTION AND QUALIFICATION OF ENGINEERS' BOYS.

"Fourth Class.—Boys on entering the service as fourth class apprentices must not be less than 14 nor more than 17 years of age; they must be of good moral character and sound bodily constitution, and able to write and work a question in the rule of three.

"Third Class.—At the expiration of their third year of service, provided their conduct has been good during that period, the boys will be considered eligible for removal to the third class if, on examination, they appear to have made themselves acquainted with the names and uses of every part of the engines, gauges, barometers, &c.

"Second Class.—If boys, in the fourth year from their entrance into the service, be acquainted, through the instruction of the engineer under whom they may be placed, with the whole principle of the engine and boilers, with the use of all the various tools, and with the mode of effecting repairs, as far as they are performed on board; if they be able to take off and replace any of the working parts; pack the slide-valves, pistons, piston rods, and stuffing-boxes; if they understand the action and condensation of steam, the return of water into the boilers, the construction of all the pumps, and of the feeding and blowing off apparatus, safety valves, &c., and can chalk out roughly the outlines of the engines and wheels, and have become generally useful, they will be considered fit for removal to the second class, provided their conduct has been good.

"Boys of the second class having attained

the fifth and last year of their service will be transferred to Her Majesty's dockyard, at Woolwich, where they will receive instructions on various subjects connected with the construction and management of engines and boilers.

"First Class.—At the expiration of the 5th year, if, on a strict examination, the boys be found qualified for the appointment of third class engineers, and if their conduct has been in all respects satisfactory, they will be removed to the list of the first class, and be considered candidates for promotion, and will take precedence according to conduct and abilities.

"Pay of Engineers' Boys per lunar month.—First class, 1*l*. 14*s*.; second class, 1*l*. 6*s*.; third class, 1*l*. 3*s*.; fourth class, 14*s*. 6*d*.

"Monthly allowance.—During the first 12 months' servitude from the time of their first entry on board the ship, 2*s*.; after 12 months' servitude at home, 3*s*.; abroad, 4*s*."

With the qualifications required of persons entering into the naval engineering service of the country, we have no fault to find, unless it be that they are so loosely and illiterately expressed. The first and second class engineers are to be "thoroughly acquainted *with the working* of the principles on which the machine *works*," while the third class engineer is to be "acquainted with *the principles* of marine engines and boilers"—as if it were meant to be said that the inferior officer must know the principles of the machinery, while it is sufficient if his superiors are acquainted with the working of these principles. Then we have the words "machine," "engine," "engines and boilers," indifferently employed to signify the same thing—"defects" in boilers, which no engineer can cure afloat, placed in the same category with derangements of machinery which he may and ought to be able to remedy on the instant; and *eccentrics* spoken of as things, the *length* (!) of which it is very necessary to be competent to adjust, &c. It would not, we presume to think, have lessened the respect with which it is desirable the instructions of the Lords Commissioners should be regarded by all their "faithful servants" had they been in this instance expressed in a more clerk-like fashion, and with a little more distinctness, clearness, and consistency.

The pay is liberal, and, so far as pay goes, well calculated to secure the services of men possessing all the qualifications required. Not so the superannuation allowances and pensions, which are disproportionately small, and very palpably inadequate.

Engineers of all the three classes are to have the rank of *Warrant Officers*, and to take precedence "*next below the carpenters*,"—that is below the lowest (heretofore) of the class, caulkers only excepted! Here is that which spoils all —a grand error which will go far to destroy all the good effect anticipated from the liberal pay and not so liberal allowances and pensions—a noxious ingredient thrown contemptuously—inconsiderately at least—into the cup, of which the sure effect must be to turn the whole to gall and wormwood.

Why *should* the engineers rank so low? A degree higher only than your handler of oakum and stopper of holes!

The qualifications required of the engineers are qualifications equal to those required of any officer of the ward or gun-rooms;—they must be persons, not only of *good*, but of *scientific* education—masters of all the knowledge of a Watt, and of almost all the decision and promptitude of a Nelson. In a letter which we lately received from the head of an eminent steam-engine building firm, there is a passage so apposite to this particular point, that we cannot forbear from here quoting it—though written certainly with no view to publication, and with little expectation (we fancy) that the valuable class of men in question were about to be so scurvily treated by Her Majesty's government. "I have been an eyewitness," he says, "to many instances of great emergency where the safety of all depended upon *the thought of the instant* —where your marine engineer has exhibited a degree of inventive power, united to a coolness of judgment and readiness of execution, such as none, but the mechanics of Great Britain, and those *the very best of their class*, could have displayed." Who, *then*, may we ask, was *chief* officer? Not either captain, or lieutenant, or master, or *even* gunner, or carpenter, or caulker, but undeniably the ENGINEER, who, everywhere else, but *at his post and in public estimation*, ranks below them all!

Between no two classes of officers is the analogy so close and striking as between the *engineer* and the *master*.

The one does all in regard to the *steaming* of the ship, which the other does in regard to *the sailing*. To whatever extent a vessel *steams* in the course of a voyage, to that extent exactly does the engineer supersede the master in his peculiar province which is that of *navigating* the vessel. When danger threatens, the master is directed by the "Naval Instructions" to represent the circumstances to the captain; but what can the master (such sailing masters, at least, as are found usually on board of ships) tell of the danger arising from a failure in steam machinery? The person with whom the captain must then consult and advise is *not* the master, but THE ENGINEER, and him alone. A new order of circumstances has arisen, which has called into being a new set of officers, to perform duties, for the performance of which the old class of sailing masters are entirely unfitted; and it seems but reasonable that the individual who has a master's duties to perform, and will generally be found more than his equal in education and acquirements, should not be inferior to him in nominal rank.

Again, the pay of the engineers, as now settled, is superior to that of all *other* warrant officers, and superior even to that of many of the commissioned officers of the service. How is it possible to reconcile such high pay with such low rank? We hold the two things to be utterly irreconcileable. Either the pay is too great for the rank, or the rank is too low for the pay. To give a man, pronounced by order of the Lords of the Admiralty to be a fit companion for carpenters and caulkers only, the income of a first lieutenant, (much more, indeed, taking all the allowances into account,) must have an inevitable tendency to produce low, grovelling, perhaps dissolute and intemperate habits—to break down and demoralize a class of men, whom it ought to be our study, to elevate as much as possible in the scale of intellectual vigour and moral worth.

No, no, Messrs. Commissioners! if you would encourage the growth of the new and prodigious power which science has placed in your hands, as it deserves and ought to be encouraged—if you would deal by the steam marine as fairly as by the other branches of the service—you will forthwith revise all that part of your present edict which relates to the "rank" of marine engineers. You have given them the pay of gentlemen—go a step further, and give them also the rank of gentleman to uphold, which will bring with it the desires, inclinations, and pursuits of gentlemen. The sort of men you want for this service are such as are to be found on shore occupying, in our steam-engine factories, the situations of overseers, foremen, draughtsmen, &c., and who must have qualified themselves for these situations by much and long training and study. Now these, in every proper sense of the word, are gentlemen already—persons who would think it much beneath them to associate on shore with those whom you propose to place them "next below" at sea. You seek to encourage these men to enter your service, and would wish, we presume, that they should not become, while in it, less valuable than they were before; and the first thing you do towards that end is, to assign them a rank which must at once degrade them in their own estimation, as well as in the estimation of others! Was there ever conduct more ill-judged, more uncalled-for, or more pernicious?

While the pay is so high, there will never be wanting men to take the situations of marine engineers; but they will not be of the superior description we have just indicated; or if occasionally a person of that description is tempted by love of gold to enter the service, you may calculate with great certainty on his losing rapidly, under the influence of your letting-down system, all the superiority he ever possessed. Overpaid or underrated, all are sure to fall short, in the end, in point of merit and efficiency.

As there are *sailing* masters and mates with the rank of officers, so also should there be *engineer* masters and mates of the same rank; not a reason can be suggested why there should be the slightest difference made between them.

And as there are midshipmen bringing up to be lieutenants and captains, so also should there be midshipmen bringing up to be engineer mates and masters. The engineer "boys" of the existing system would then soon give place to engineer midshipmen, of a much higher grade, both in point of birth and education.

With the rank of officers, the engineers should also have retiring allowances suitable to that rank—half-pay, in short, on

the same scale as other officers, and not such contemptible steerage class "pensions" as are assigned to them by the present Rules and Regulations.

We feel perfectly satisfied, in short, that until the steam engineer department of the navy is placed, in every respect, on the same footing as the sailing, fighting, and civil departments, it will never be equal to them in efficiency, or productive of half the excellent service which it is capable of rendering to the country.

After finding so much fault with the Lords of the Admiralty for their treatment of their steam engineers, it gives us much pleasure to record a mark of honour recently conferred by them on one individual of this class, which shows that their Lordships are not, after all, without a growing sense of their claims to higher consideration. On the return home of the *Tartarus* steamer, after an absence of upwards of four years in the West Indies, her machinery was found in a state of such perfect working order, as, with the exception of the boilers, to require scarcely any repair. During the whole time, too, she was on the West India station, she never failed, in a single instance, to perform the duty assigned to her; a circumstance the more to be valued, that on that station no means of making any engineering repairs exist, so that, had any accident of moment befallen the machinery, the vessel must have been either laid up, or have returned to England. The Lords of the Admiralty, considering that such admirable results could not have been obtained, except through first-rate conduct and ability on the part of the principal engineer, have ordered a silver medal, with a suitable inscription, to be struck, and presented to him. No doubt the machinery must have been first-rate, too, which the Engineer had to superintend and work; but instances are not rare, of very excellent engines turning out very badly in incapable hands. The engines of the *Tartarus* were built by Messrs. Miller, Ravenhill, and Co., and *are*, like all the productions of that eminent firm, nothing but first-rate, in point as well of materials as of construction and workmanship.* Much, also, of the success of the *Tartarus* is doubtless to be ascribed to the commander of the vessel, Lieut. T. W. Smith, whose conduct we have heard spoken of in the highest terms, as being in every respect what that of a commander who has "silver medal" men under him should be. His arrangements for the comfortable lodging of the crew, and the perfect ventilation of the ship—his constant solicitude to promote their comfort and happiness, and to make their labours as little like labour as possible—have been more particularly described to us, and we believe with perfect truth, as being beyond all praise.

## WHO FIRST INTRODUCED THE USE OF EXPANSIVE STEAM FOR MARINE ENGINES?

[From the "American Repertory of Arts, Sciences, and Manufactures."]

If the reader believe, as we do, that the history of the marine engine would not present the series of astonishing successes it does, but for the introduction of expansive steam, he will deem the question we have placed at the head of this article one of exceeding interest; and, if there are rival claimants, one that cannot be discussed too early.

In an article contributed by Professor Renwick for Tredgold's late work on the steam-engine, he says: "It appears probable that the use of a valve, cutting off the steam at half stroke, had at first no other object in view than a saving of fuel. The person who first ascertained, as a practical result, that a greater speed might be attained in a given vessel by using steam expansively was Adam Hall—at that time the director of the workshops of the West Point Foundery Association. He, at all events, entered very fully into the practical investigation of this subject, and drew up a paper exhibiting his views, which was communicated to the writer of this essay. The same views had been previously exhibited theoretically, by the writer, in a public course of lectures delivered in February and March, 1830. These were soon after made public, in a treatise on the steam-engine, which, it is believed, had some

* Messrs. Miller and Ravenhill have fitted fourteen other vessels with engines constructed from the same models as the *Tartarus*, eight of which were for foreign governments Those of the *Tartarus* are two seventies; and their average consumption of fuel, when on the West India station, did not exceed from 8½ to 9 tons in the 24 hours.

influence in the improvements that have since been made in navigation by steam."

Professor Renwick, we think, is in error, both as to the gentleman named in this article, and the date at which he fixes the discovery. We have been put in possession of a number of facts, which go to prove conclusively, that the person who first used steam expansively, and at a much earlier period, was F. B. Ogden, Esq., of New Jersey, now or late U. S. consul at the port of Liverpool.

As early as 1808, when Mr. Fulton was making his first trials on the Hudson River, the attention of Mr. Ogden was attracted to the steam-engine, as connected with navigation. In 1811, he assisted in a series of experiments made at the instance of his uncle, late the governor of New Jersey, with the view to its introduction on a ferry owned by the latter, between Elizabeth-town Point and New York. This led him to a close investigation of the subject, when he was forcibly struck with the extraordinary advantages to be derived from using the expansive power of steam, which, to his astonishment, had never yet been made available. He made a drawing that year of a double engine, united at right angles, to consume the same quantity of steam required for a single one; that is, cutting it off at ½, and using it expansively for the rest of the stroke.

At the breaking out of the war, his attention was attracted to other objects, and the subject of steam was not again entertained until 1813, when appointed to the superintendence of the building of two boats at Pittsburgh, for a company in New Orleans, he had leisure to give it his full consideration. This resulted in an application for a patent, which was granted, bearing date 31st December, 1813. His claim was therein set forth as "combining two or more cylinders in such a manner as to form one engine, with the view to cutting off the steam, of whatever pressure, at ¼, ⅓, or ½ the stroke of the piston, and using it expansively for the residue." Incidental to this he claimed, "the arrangement of the cranks at right angles in two cylinders, or at 120 degrees in three, thereby enabling them to carry each other over the dead points."

In 1814, an engine was constructed under the sanction of Mr. Ogden, by B. H. Latrobe, Esq. for a woollen manufactory at Steubenville, Ohio, which gave great satisfaction to the proprietors; and in the following year he had his first marine engine placed on board a boat of 230 tons, to run on James River, between Norfolk and Richmond. The engine of this boat was built in Elizabeth-town, N. J. It consisted of two cylinders, 27 inches diameter, with a 4 ft. stroke shutting off the steam at ½.

In 1816, Mr. O. went to England, for the purpose of having an engine built there. He submitted his plans to some of the most eminent engineers of the day, and among others, to the celebrated James Watt. To use the words of our informant, "he often speaks with great interest of his interview with that celebrated man. He had met with incredulity and doubt in some to whom he had explained his views; but no sooner had Mr. Watt examined his plans and heard his explanations than he exclaimed, 'I do not hesitate to say, Mr. Ogden, that this will make you a beautiful engine, and that you will derive the advantages you anticipate from it.' In reply to Mr. Ogden's question, if he was right in believing himself the inventor? he said: 'The expansive power of steam has been long used in Cornwall, where much larger engines are erected than are at first required: of course, they are not put to their full work; ¼ or ⅓ of the power being sufficient, the cylinders are only thus far filled with steam, and the residue of the stroke is made by expansion.' 'Two or more cylinders have also been so placed as to be combined when required; but I am not aware that they have ever been so united with a view to the advantages your propose.'"

An estimate for the work was made out by Messrs. Watt and Bolton; but it so far exceeded Mr. O.'s expectations, that he was induced to apply to Messrs. Murray and Co. of Leeds, whose offers were so much more moderate that he immediately contracted with them for a double acting engine, consisting of two cylinders, 30 inches diameter, 4 ft. stroke, with double condenser, air-pumps, &c. &c. so united that the power of each should be communicated to the same shaft by cranks at right angles with each other, a throttle valve to be attached to each cylinder with a cut-off at ½ stroke. The whole weight of the engines and boilers when completed was 68 tons. Mr. Murray was an ingenious, practical man; he took great pride in the job; nothing to be compared with it in magnitude for marine purposes having yet been undertaken in England. But he never could be made to understand the principle of expansion, insisting to the last that *wire-drawing* the steam would produce the same effect. It was only through Mr. Ogden's positive orders that the throttle valves and cut-offs were introduced.

In the mean time his patent was infringed in a variety of instances on the Mississippi and Ohio rivers, both in high and in low-pressure engines, for one of which piracies he brought a suit in the District Court of the United States at New Orleans, and obtained a verdict for 1000 dollars. An appeal

was taken to Washington, where the verdict was confirmed.

In 1824, Mr. Ogden purchased in New Orleans an engine which had been built by Murray and Co. from the same patterns that had been used in the one built for him in 1817. He had it brought to New York, and employed the West Point Foundery Association to set it up on board a vessel he had built for a tug-boat on the Mississippi. The work was done under his immediate and constant supervision; and among the men employed was Mr. Hall, of whom Prof. Renwick speaks as the person entitled to the credit of first ascertaining the practical result of using expansive steam.

We have here given, in the most concise form, the evidence upon which Mr. Ogden's claim is based: comment might have hidden the strong impress of truth it bears. We cannot but express our surprise, however, that his native country should have withheld a right that has been freely yielded to him in England. In the London Mechanics' Magazine for the year 1829, his pretensions are clearly and boldly set forth, challenging contradiction: they have remained uncontradicted to this day. A few years since, when the project of establishing a regular communication by steam between England and the East Indies was a prominent topic, evidence was given before a committee of the House of Commons by a number of engineers and scientific gentlemen, upon the various matters affecting the proposed measure. So strongly associated with the use of steam expansively was Mr. Ogden's name at that time, that he was called upon to give the results of his experience with it in marine engines, and also to furnish such other information respecting the navigation by steam of our rivers and lakes as the committee desired to obtain. Those who may feel enough interest in this subject to search for authorities, if they have not access to the Report of the committee, will find in the Edinburgh Review, Vol. LX, a very able review of it, in which a principal part of Mr. Ogden's testimony is quoted at length.

## FRENCH PROGRESS IN STEAM-ENGINE MAKING.

Lyons, August 8, 1842.

Sir,—I have been for the last eighteen years a constant reader and admirer of the *Mechanics' Magazine*, though, unfortunately, I do not sometimes receive it till two months after date. To fill up the vacancy, I take in some French publications, one of which, entitled "Publication Industrielle des Machines Outils et Appareils, par Armengaud ainé," is a respectable journal, with well-executed drawings of machines of every description. In the Number of this work for the last month, there is rather a remarkable Report by the Academy of Sciences, on a communication by M. Clapeyron, "On the setting of valves of steam-engines." Should you think the nearly literal translation of it which I subjoin worth insertion, it may help to give your readers some idea of the relative positions of England and France, in regard to steam-engine making, at the moment when France has so magnanimously resolved to be no longer tributary to England for machinery! The gravity with which the expansive system is announced by M. Clapeyron and his friends of the Academy, as quite a new discovery, is as amusing as it is instructive.

*Report on a New Method of Setting Valves of Steam-engines, by M. Clapeyron, of Paris.*

Constructors of steam-engines have long since found that it was advantageous to place their valves so that instead of beginning to open at the instant when the piston has arrived at the end of the stroke, they shall precede the piston a little; this is effected by a slight modification of the valve. They likewise observed that this arrangement had the effect of shutting the steam opening some time before the end of the stroke, and thereby causing the steam to act expansively. Until lately, very little importance was attached to this last circumstance; the expansion being proportionally small, it was looked upon as the necessary result of the disposition destined to produce the before-named effect (opening the valve sooner.)

The intention of the author is to develope this last circumstance, which has been looked upon, till now, as a secondary effect, from which nothing useful was to be drawn. He shows, by the most simple modification of the common apparatus, that the three following conditions may be satisfied:—

1. That the introduction of the steam may precede the end of the stroke a given quantity.

2. That the escape of the steam may precede the end of the stroke a greater given quantity.

3. That the expansion of the steam will begin at a given point in the length of the stroke.

M. Clapeyron gives a geometrical diagram, by the aid of which may be found, in an easy and simple manner, the dimensions of

the valve, and the position of the eccentric to satisfy these three conditions.

In consequence of this disposition, the escape opening will be shut before the end of the stroke, so that the steam at the atmospheric pressure, *in a non-condensing engine*, will be compressed between the piston and the valve, thereby absorbing a great quantity of power. This compression is in proportion to the expansion, and may at first sight appear to reduce the power of the engines greatly.

The author shows, however, that to do away with this loss of power, the space between the piston and the valve, at the end of the stroke, ought to be such, that the compressed steam shall be equal to the pressure in the boiler at the moment the valves begin to open.

This improvement was applied by the author, in the year 1840, to one of the locomotives on the Paris and St. Germain Railway, when, with a consumption of fuel scarcely equal to that of the most powerful English engines, it has, at the same speed, drawn 50 per cent. more load (!!!) This engine has been ever since in regular service, and still maintains its superiority (!!!)

This *new* way of working by expansion, for which the author claims *priority*, has the advantage of not requiring any new machinery; it has been used in England for some time past, and will, no doubt, become general (!!!)

*Note by the Editor of the "Industrielle."*

The details of the system proposed by M. Clapeyron, to work steam expansively, consists principally in the construction of the valve, to which a greater quantity of *lap* is given than formerly. It has been applied, to a certain extent, to steam navigation, and will, no doubt, extend to land engines (!!!)

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I might name many other inventions that are deemed new here, but which may be seen in some of the earlier volumes of the *Mechanics' Magazine*, published 10 and 15 years ago. It is really amusing to see an old acquaintance, who many years since passed before us in a threadbare coat, out at the elbows, appear once more gaudily dressed in a Parisian *paletot*, of the newest *academic* cut. Not that I mean to say that the above method of setting slides is either threadbare or out at the elbows. It is a very sound and good method, and has no other defect than that of being—not new.

I am, Sir, yours truly,

TIROIR.



THE CRANK QUESTION.

Sir,—When I perceive how completely your correspondent "M.," has avoided saying anything on the real points at issue between us, I do not wonder at the shifts he has been driven to, to try and fill up his last letter. He was evidently puzzled how to manage writing a make-believe answer, when he found himself unable to contend any longer for his former conclusions, about which he had been so confident; and hit upon the expedient of taking to his old plan, of groundlessly charging me with misrepresenting him; going, I am sorry to say, still farther now, as he does not scruple to ascribe to me assertions which I never made; for in the first place, Sir, he actually charges me with having alleged that he had abandoned as untenable his previous position, that there was a loss proved by his experiment; whereas I really asserted the very contrary, viz. that it appeared to me that "M." had so completely annihilated his own conclusion, "that I need scarcely have noticed it again had he not very coolly" "told us that his arguments were *as sound as ever!*" He also accuses me of giving "garbled extracts" of his papers; but he does not seem to understand what garbling means: to constitute a garbled extract, as I understand it, a part must be *suppressed*, which would qualify *the meaning* of that part which *is given*: but to say, that I have given garbled extracts, because I have not quoted enough of his letter, to let it be "seen that" he "contended for a loss of power equivalent to 20," is absurd in the extreme. Any body that wanted to see what *he* was contending for, might refer to his letter; *the* object was to refer to his *facts*, and draw from them a *correct* conclusion, and I used his own words to ensure correctness in the reference. Now there was no room for garbling here, for he cannot deny the correctness of the facts, viz. that (at page 259), he told us that the *work performed* was represented by the number 149, and at page 470, that the *power expended* (in this same case) was 135 only. What then, may I ask, have I done "unfairly" here? My object being from these premises, *thus brought together*, to show that there could not be the loss of power "M." contended for, in this case: and from these facts, when they were thus brought into juxtaposition, I did certainly presume that your correspondent would allow that there *was* no loss of power, *as far as the case went*; and, from his studied silence in his December letter (page 470), as to whether there really *was* or *was* not a loss *shown* by that experiment, I did undoubtedly, and do still think, that he felt himself unable to show the existence of any such. I know he contended that

there *would be* a loss of power equivalent to 20, but *that* is *very different* from showing what there *was;* besides, his argument there depended upon a mere supposition, and, as a *proof,* was utterly worthless; so that instead of finding fault with me for not repeating it, he ought to have been obliged to me for passing it over so lightly; for what, Sir, do you suppose is the foundation of this argument which he guards with such jealous care? Simply this, an *assumption* "for argument's sake" (mark, to *help out his argument,* not to assist in arriving at the truth), "that 5 lbs. additional weight would be sufficient" (i. e. that 5 lbs. added to the 50 under the table, would be sufficient to draw the 37 lbs. weight 6 inches.) Truly this is a very *convenient* method of investigation; what a pity it is not a little more *experimental!* This *conclusive* argument was not, however, so unnoticed as "M." seems to think; for though I did not remark upon the *method* of it, considering that I could afford to pass by a minor fault, having so many greater ones to expose, yet I showed him the fallacy of supposing that either 50 or 55 lbs. could, by his apparatus, move the 37 lb. weight over the space of 6 inches; he seems, however, not to have apprehended this part of my letter, and perhaps I may have been a little too concise; I shall therefore touch upon this subject again. It appears that in the original experiment *before* the cross bar came against the stop *d*, the 50 lbs. weight (suspended under the table), moved 2 inches, the 37 lbs. weight on the table being carried by it the same distance; but that *afterwards* the 50 lbs. moves only 0·7 of an inch, while the 37 lbs. is carried 2 inches, so that one moves nearly 3 times as fast as the other, and is therefore acted upon at a mechanical disadvantage of nearly 1 to 3. Now if we suppose, as "M." assumes, that the 5 lbs. added to the 50 would cause it to move 4 inches (in its whole course) instead of 2·7 inches; then, previous to the bars coming against the stop, both the weights will have moved 2 inches, and the quantity moved by the 37 lbs. afterwards, may be ascertained by the following proportion, 0·7 : 2 :: 2 : the required distance, which will therefore be equal to 5·7. Adding to this the 2 inches moved previously, we shall have the entire distance traversed = 7·7 inches, and consequently the work done = 37·3 × 7·7 = 287·2, while the power expended would be only, according to "M.'s" own showing, "55 × 4 = 220." If then, Sir, your correspondent's expectations had been fulfilled here, I say, as I said before, his crank must have *increased* the power instead of *diminishing* it.

If any of your readers, Sir, have taken the trouble to observe how regularly I have canvassed and *refuted* every statement of "M," and how he has scarcely ventured to bring forward again three or four out of twelve or fifteen objected to, and has not even succeeded in establishing *one* of these, it must appear to them ridiculous enough to have him accusing me of "*beating a retreat,*" and hinting that *I* was *hard pressed!* (*By whom,* I wonder?) And charging me with pretending to misunderstand him, when I find it more convenient to do so *than to refute his arguments!*

There is one thing, however, that I *perfectly* agree with "M" in, viz., that "it is very necessary" for him "to *explain, in language that cannot be misunderstood,* what" *his* "meaning of the term, loss of power, is;" this he professes to do in his last letter, but nowhere, in the whole of it, can I find the *smallest explanation in language* on the subject. He attempts to *exemplify* what it *is,* but does not make the least attempt to define *his meaning.* His exemplifications, too, are curious enough. He supposes a case of two engines, one rotative, and the other a crank engine, and then tells us, that if the one is found to do more work than the other, then there is a loss of power in the crank; and that *this* (what? this *loss of power?*) is clearly the *meaning of the term* loss of power. This puts one in mind of Bardolph's definition—

> "Accommodated? That is, when a man is, as they say, accommodated. or, when a man is,—being,—whereby,—he may be thought to be, accommodated; which is an excellent thing."

Your correspondent is evidently determined not to commit himself by an explanation, though he talks so big about giving one, requesting me to be *as explicit* as he is! He will not even say how far he agrees with my definition of the term "loss of power;" and really I don't know how I could be more explicit than I have been. Either there *is a loss,* owing to the crank, or there *is not;* if there *is* a loss of power, it must be *irrecoverable,* otherwise it is not *lost;* but if it *is* recoverable by any contrivance, then it is not *lost,* and then, therefore, there is no *loss;* there may be a mechanical disadvantage which is neutralized by that contrivance; but, that a mechanical disadvantage is not what he means by *a loss,* "M." has allowed in one of his former letters.

Your Aberdeen correspondent, "A Mechanic," mentioned some time ago, (vol. xxxiv. page 439,) an experiment comparing a rotative with a crank engine, and stated that the *power* of the former had been found "much greater, nearly double" that of the latter, and then proceeded to show why it was so—that if the crank-engine had raised

*the same weight*, it would have done so with *a greater velocity*, and therefore that the effective power of the engine would have been *increased;* so that we should have had *more work* done by the crank engine than by the other, if they had moved equal weights. "M.'s" representation of this case is like some of his other representations, which ill-natured people would be apt to call *mis*-representation, and exaggeration too; for, instead of saying that one engine had *nearly* double the *power* of the other, he says that your northern correspondent admitted that the crank engine did *not do one* half the *work* of the other! If "M." can give us no better example of loss of power than this, I fear his boasted loss will dwindle down to be no more nor less than a *mechanical disadvantage;* the existence of *this*, in part of the crank's course, nobody will deny, and it is evidently all that is exhibited by "A Mechanic's" experiment.

A curious mental hallucination seems to have taken possession of "M.," in part of his letter, where he attacks me about "friction," particularly in the following sentences. Telling us of the friction of drawing a spike out of a piece of timber, he says, "but your correspondent cannot dispense with the friction of the spike;" and again, "now, your correspondent is disposed to turn round and cavil with me about this friction, on the ground of a misunderstanding about words, and that this friction was excepted." Now, Sir, would you believe, if you had not read my letter, that in no one part of it, from beginning to end, did I once mention friction, or even *allude to it directly or indirectly*, except where I remarked upon the well-known elementary law of friction, the truth of which "M." denied.

These friction notions "M." seems (from what he says) to have extracted by some new process (worthy of being patented, as it discovers things which have no existence) from some observations I made on the action of a fly-wheel, saying that some work could not be well done without it; but what has this to say to friction? The case is the same, whatever the work consists of, if it is uniform: he objects that in this case my crank will not move without momentum. Who said it would? I am sure I never did: I know it cannot: but, when we give it the momentum with a fly, and find that *the work is done*, what reason have we to suppose that power has been lost? The fly acts as a *reservoir*, receiving, and as it were laying up in store, the overplus power at certain points, where the force exerted is *greater* than what is necessary to perform the work; *giving out* its store at other points, where the force exerted is *not sufficient* to perform the work: anything that would perform this office would answer just as well as a fly-wheel. In a steam-boat where two engines are used, with cranks at right angles, no momentum is required: does "M." contend for a loss there?

From what "M." says here, he seems to agree in considering the fly-wheel as an indispensable addition to the crank, and an assistance, but in a former letter he told us that *it* was the cause of an additional loss! —which however he has never attempted to show.

Your correspondent is very fond of *alluding to* the doctrine of virtual velocities, but he never goes any farther: he tells us that *if* it applies to the crank, *it must also apply to his experiments;* thus pretending to answer an objection, which nobody ever made (by the bye, this is a sophistical method of replying, which he is growing too fond of, and has made use of in several parts of his letter.) In one of my first letters I told him that there was nothing in his experiment at variance with this doctrine, and he has never attempted, *before* or *since*, to *prove* that there was.

As to his non-momentum experiment, I do not consider it necessary to make any reply to what he says on that subject in his last letter, for he has not been able to answer the two objections in the sixth paragraph of my last letter (p. 76), the latter of which puts him in the dilemma of either showing that he does not understand the action of the spring in his own experiment, or, that the loss he talks of is only apparent, not real, and has nothing to do with his crank.

There are several minor matters in "M.'s" letter scarcely worth notice; but I may just remark, that *if* I did say (as he has *quoted*), "get a suitable apparatus and it can be done," I did *not* mean, "take away the crank;" I should rather have said, Keep the crank; but suit it to your work. Well might "he" wonder if he thought I was in earnest, at my calling the power *lost*, where it is capable of being reproduced; I should have put a note of admiration after *lost*, and then perhaps he would have understood that I called it so *ironically*, to show the absurdity of his believing in such a contradiction. Why does not 74 × 3 answer the conditions? I had as much right to use "M.'s" argument in finding what weight should be carried 3 inches, as he had in finding the same for 6 inches. My addition to "M.'s" apparatus would not in any way meddle with his crank, but I have not time or space to give it now.

And now, Sir, concluding this letter as I began my first, my object being still to show "M.," *that there is no loss of power in the*

*crank*, I leave it with your readers to decide, which of us is most inclined to "beat a retreat," and "shift his ground;" and which of us is most inclined to give clear *definitions* of what he is arguing for, from which he cannot afterwards depart.

I am, Sir,

Your obedient Servant.

R. W. S.

## ABSTRACTS OF SPECIFICATIONS OF ENGLISH PATENTS RECENTLY ENROLLED.

GOTTLIEB BOCCIUS, OF NEW ROAD, SHEPHERD'S BUSH, MIDDLESEX, GENTLEMAN, *for certain improvements in gas, and on the methods in use, or burners, for the combustion of gas.* Petty Bag Office, July 27, 1842.

These improvements in the combustion of gas, as adapted to the purposes of illumination, are stated to consist in applying above the surface or jet-holes of the burners two or more concentric chimneys or cylinders in addition to and within the usual chimney of glass. The internal concentric chimneys are connected together and kept at the proper distance from each other by rivets or other convenient means. The material employed for the body of the burners is iron, brass, copper, or other suitable metal; but for the upper surface through which the jet holes are pierced, the patentee uses thin German silver soldered into it. He prefers the latter metal for the perforated surface of the ring, having found it "very proper for the purpose, and very durable, on account of the high temperature required for its fusion." He generally forms the central chimney of thin sheet iron, as a cheap and durable material; but glass, or any other metal or substance, whether transparent or opaque, capable of withstanding the heat, will, it is said, answer the end. When metallic central chimneys are used, it is thought not to be necessary that the whole of the external chimney should be of glass. "In burners of a large size it may be more economical to have a glass rising above the ring only to the height of the lower edge of the internal chimneys. In such cases the upper part of the external chimney may be of metal, and be connected with the two internal chimneys, and in situations where the invention can be placed within a glass lantern, as in the streets, the glass chimney may, without any material loss of effect, be altogether dispensed with, leaving the three concentric chimneys just described suspended above the ring." With respect to the dimensions of the chimneys, he has found that in the single ring burners the diameter of the innermost chimney should not be much greater or less than the diameter of the burner, and that the diameter of the second chimney should not be much greater or less than the external diameter of the ring of the burner. The distance at which these chimneys are fixed above the surface of the jet-holes may be greater in small than in large burners. The patentee finds that the lamps act perfectly well when this distance is equal to the diameter of the flame at the orifice of the holes; but that in small burners the length of the flame may be beneficially increased. In burners consisting of two or more rings, these dimensions have reference to the diameter of the outermost or largest ring and flame. As a general rule for the diameter of the innermost chimney, and also for the length of flame, it must be such that all the flames shall enter that chimney, which they will do if the chimney be made of the prescribed proportions. In constructing burners of two or more concentric rings, the patentee places the inner ring at a certain height above the outer one, or that next to it. The object of this arrangement, which he considers to be a great improvement on burners of the same kind heretofore made is, to provide for the greater equality of the height of the several cylinders of flame in such burners so that they shall terminate as exactly as possible at one and the same level, and all enter the central chimney together. He finds by this arrangement that the economy or luminous effect arising from the combustion of a given quantity of gas is much increased, an effect which he attributes in great measure to the circumstance, that nearly equal luminosity is obtained in the flames from each ring at equal heights above the surface of the greater or external ring. He has found, also, that the height of the surface of one of these concentric rings above another should be a little more than the depth of the ring. In order to provide for a more equable distribution of gas to these burners, the junction between the rings is so arranged that the gas first enters the largest ring from the service-pipe—passes thence into the second ring, through a series of pipes—and, lastly, into the outermost ring through another set of pipes. In order still further to equalize the height of the flames, and to produce an uniform luminosity in the several flames, he finds it requisite to make the jet-holes of the inner rings somewhat larger than those in the outermost ring. The perforations or jet-holes which the patentee finds to give the best results, are very small in a burner of one inch diameter; for he has found it advisable, he says, to have from 60 to 65 very small holes, in order to pass about 3 cubic feet of gas per hour;

whereas the common Argand gas-burner has usually from 12 to 15 holes of a larger bore, to give equal light when consuming a much larger quantity of gas. In the case of the larger burners, he drills the holes at a distance from each other of about one-twentieth of an inch. As a general rule for the combustion of gas according to his improvement, he considers it necessary to observe that the quantity of gas supplied, or height of the flame, should be such that its top is just received within the lower edge of the innermost central chimney. "When this is the case, the combustion will be found very perfect, and the light brilliantly white. No carbon will be deposited within any of the chimneys, and the light will be perfectly steady, the lower edge of the central chimneys defining the upper part of the light, so that the jagged or irregular edges and flickering so unpleasant to the eye in common gas-burners does not exist, and the light appears of a permanent form, as a truncated section of a luminous cone." Although a circular form of flame alone has been previously mentioned, the patentee states that the same improvements in the combustion of gas will be attained if a form of flame, bounded by straight lines, or other form than circular, be employed, provided a corresponding change be made in the form of the chimneys and apparatus.

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*Note.*—Mr. Boccius has entered a disclaimer with the clerk of the patents, of the same date as his specification, in which he states, that having, since the date of his patent, been advised "that part of the said invention is not new and useful," he disclaims the following words of the title, "in gas, and on the methods in use, or burners"—so that the title, as thus amended, stands as follows,—"certain improvements for the combustion of gas."

ADDERLEY WILCOCKS SLEIGH, K. T. S. OF MANCHESTER, CAPTAIN IN HER MAJESTY'S SERVICE, *for a certain method or certain methods of effecting and forming sheltered floating harbours of safety by the employment of certain buoyant sea-barriers applicable thereto, and which said improvements are also applicable to and useful for the formation of breakwaters, floating bridges, lighthouses, and beacons, the protection of pier-heads, or embankments, and for other similar purposes.* Rolls Chapel Office, Aug. 8, 1842.

Captain Sleigh states that his invention consists in the construction and adaptation of sloping or oblique platforms mounted upon, connected to, or supported by floating hollow vessels or caissons, by which the platforms are always maintained in sloping or oblique positions and are enabled to rise and fall with the tide. These floating vessels and sloping platforms, when constructed, are to be so arranged as to form sea and wind barriers for sheltering ships and other vessels, and also pier-heads, bridges, and other structures requiring such shelter from the ordinary destructive effects of heavy seas and gales of wind."

The ideas of the patentee are illustrated by a sectional view of a breakwater constructed on his system. The hollow vessel or caisson is represented as consisting of ribs of timber strongly planked on the outside and made perfectly water-tight and buoyant; but it may be constructed, it is said, of sheet iron or other suitable material if desired. It is of a peculiar shape, being of the form of an oblong longitudinal wedge, with the back part rounded like the side of a vessel, and the bottom perfectly flat, whilst the upper surface or deck rises at an acute angle from the extreme edge of the bottom, forming an inclined plane, which extends longitudinally the whole length of the structure. Through the centre of this caisson and along its whole length extends a strong timber beam or keel, which will be the centre of motion on which the caisson floats. The top, bottom, and sides of the caisson are supported and strengthened by internal stays or bracings arranged in any suitable and convenient manner for the purpose of giving stability to the structure. The sloping or inclined platform is mounted upon the upper surface of the vessel and firmly secured to it by wooden or iron bracings or stays. Strong rings are attached for moving it securely in any desired place. The lower end of this platform is to be immersed in the water, and its face or inclined plane to rise therefrom at an angle of 30° (in imitation of the slope of the supposed beach) to a considerable distance beyond the top of the caisson or vessel, thereby "offering a modified resistance to the violence of the winds and waves, by which means their destructive effects will be much lessened, and the water behind screened or sheltered from the action of the tempest."

These floating breakwaters may be made of any dimensions, and in order to form a sea and wind barrier or harbour of refuge, a suitable number may be moored side by side, either in a straight or curved line as may be required. They are to be connected together by universal ball and socket joints, or links and toggle joints, placed at the ends of the keel or beam, "by which they will be allowed to roll upon their centres of gravity, or yield temporarily in any other way to the violence of the winds or waves."

The manner of arranging these sea barriers or floating breakwaters, to form a harbour of

refuge is shown by drawings, in which they are shown connected together in the manner before stated, and are moored to the bottom of the sea by chains or cables attached at one end to the rings before mentioned, and at the other end to anchors fixed to the ground under the water.

In place of the peculiarly shaped caisson or floating vessel before described the sloping platform or inclined plane may be attached or connected to a floating frame-work, supported by a number of barrels or other hollow wooden or iron vessels, or the inclined platform may be borne by a wooden frame-work or raft. The platform may be employed even without any floating support by connecting it at one end by means of chains, cables, or otherwise to the bottom of the sea, in such a manner that the upper edge may rise from the water in an inclined direction.

Claim.—"I wish it most distinctly to be understood, that I do not intend to confine myself to the methods herein shown, and described, of constructing and floating my improved sea and wind barrier, but claim as the invention the employment as breakwaters of portable sloping platforms, or inclined planes, partially immersed in the water, in whatever manner or of whatever materials such inclined planes may be constructed, or in whatever way they may be floated or buoyed up, in, or on, the water, and held in the required situations when such portable and buoyant inclined planes are employed for the purposes or objects above stated."

## INSTITUTION OF CIVIL ENGINEERS.
### APRIL 5, 1842.

### *Colonel Jones's Observations on Breakwaters.*

[Discussion concluded from our last, page 189.]

Mr. Macneill had seen at the mouth of the Helder, in North Holland, banks, nearly vertical, constructed of sea-weed and hazelwood fascines, backed with clay: they were exposed to a very heavy sea, and yet stood extremely well—there was considerable elasticity in them, for when a wave struck them the vibration was felt at a distance along the bank. In other situations on the coast of Holland the sea-banks are long slopes of sand at an inclination of 10 to 1, thatched with straw: in many places groins were built to break the length of the wave and to diminish its force; he had adopted similar groins, and found them answer perfectly.

Mr. H. R. Palmer observed that the form suggested by Colonel Jones for the faces of breakwaters did not appear sufficiently justified by observed facts; the idea was entirely of a speculative character, and was contrary to the laws of nature, which should be the engineer's chief guide. Many years ago Mr. Palmer had occasion to study very carefully the motion of the shingle beach at the harbour of Folkstone, and at several other places, and the results of his observations were published in the Transactions of the Royal Society. He found that the slopes of the surface were always regulated by the force of the waves, and the angle at which they impinged; and that when the forces were at right angles with the line of beach the whole of the pebbles were brought down below the level of the acting forces.

At Folkstone, when the sand was thus left bare, the surface stood at an angle of 9 to 1, and that slope resisted the force of very heavy seas.

The effect of the action of the sea upon an upright surface was observable in every cliff upon the coast, and the tendency to destruction was everywhere obvious.

Shingle beaches might be considered as adjustable barriers, but in the construction of piers it was necessary to adopt some precise form. When circumstances required the walls to be nearly vertical, the line of their direction should be determined with reference to the prevailing winds. Those portions of the piers of Swansea harbour which formed even only a small angle with the prevalent winds remained firm and substantial, but that part which was directly opposed or at right angles to them has been undermined. In a design of his for a pier in Mount's Bay at Penzance, Mr. Palmer had so arranged that the angle of the main pier should be at 5° with the line of the greatest forces. Thus then a horizontal slope is in fact made as a substitute for a rising one. He attributed the failures alluded to by Colonel Jones more to defective workmanship than to faults in the principle of the structure.

Mr. Palmer exhibited and presented to the Institution plans of Ramsgate, Dover, Folkstone, Swansea, and Penzance harbours.

In his observations of the action of the sea upon various parts of the coast, General Pasley had remarked that the slope of the beach was exactly in accordance with the materials of which it was composed; if it was shingle or decomposed rock or soft material, the slope was gradual; but if the shore was rocky, the waves had not any serious effect upon the bluff face opposed to them, except in the case of chalk cliffs. He conceived, therefore, that a perpendicular wall constructed of large ashlar work well cemented, would assume the character of a rock, and all the prejudicial action of the receding wave would be avoided.

Mr. Bull stated that the banks of the

river Calder in Yorkshire, had been effectually secured from damage by means of stone pitching or setting, laid at an angle of from 45° to 50° with the horizon, and resting on a mass of stone thrown into the bed of the river below the level of the water in dry seasons. These loose stones had generally been laid at an inclination of about 25° or 30° where the depth at low-water was not great; but where the water was deep the lower part of the slope had been made at about 45°, returning at the upper part or near the surface of the water to the former angle of 25° or 30°. The pitching, composed of oblong stones, was laid in courses with nearly vertical joints, having the least sectional area exposed to the action of the flood waters. The stones were from 15 to 20 inches long, varying in their widths, and were laid on a bed of gravel, or soil, he preferred coarse gravel, as it was less liable to be washed out from behind the stones, which sometimes occurred with soil, unless it was of a strong clayey nature. Several miles of facing done by him in this manner had now being standing between seven and nine years without requiring any repairs. In a few instances when the loose stones at the foot had been either insufficient in quantity or so small as not to resist the action of the floods, and had been washed away, the pitching had slid down into the bed of the river without being otherwise disturbed; after it had settled, the top part had been renewed and the original line restored.

The floods in the river Calder frequently rose from 8 feet to 12 feet, and flowed with a very rapid current, consequently the pitching had to resist a powerful action, particularly at the concave side of a bend in the river, where the action was both directly upon and along the face of the work. The loose stones below the low-water mark were seldom disturbed by the floods, and where they had been removed, no damage had been sustained beyond the sliding down of the pitching as before described; such, however, had not been the case where from peculiar circumstances a perpendicular or nearly perpendicular wall had been built instead of the pitching; in such instances a slight disturbance of the loose stones had frequently caused the destruction of the wall. Where the pitching had been backed with light soil, which was easily washed out through the joints, the stone-work had fallen into holes as might be expected, but where a good strong gravel had been used for the backing, no such instances had occurred.

Mr. Bull differed from Colonel Jones's opinion as to breakwaters with a vertical or nearly vertical face, because any disturbance of the footing, however slight, must have a tendency to overthrow the wall, and that tendency would be in proportion as the angle of the wall diverged from the angle of repose; that is to say, if the wall was quite perpendicular a comparatively small disturbance of the foundation or footing would destroy the equilibrium and the superstructure would be overthrown, but the nearer the face approached the angle of repose, the greater would be the security.

He did not mean to assert that the angle of repose was the best for the face of a breakwater, or that the same angle should be preserved from below low-water mark to the top of the structure; on the contrary, he was inclined to think that a curved section commencing from a few feet below low-water mark at an angle of 10° or 15° from the horizon and terminating at the top at an angle of 70° or 75° would be found a good form, and if the courses of face stones were laid nearly vertical, should the footing below low-water mark be removed by the action of the waves, the consequence would be a sliding down of the upper face which could easily be replaced at the top, as is done with respect to the river pitching.

The proper angle for the loose stones below low-water mark would, he had little doubt, be that of repose, or nearly so, as Colonel Jones had shown to be the case in several existing breakwaters.

The face stones should be roughly squared on the beds and joints, or what is called in the North "scappled" to the form of the curve, and laid in equal courses not quite perpendicular, but inclining a little from the direction of the prevailing wind, perhaps about 10° from the vertical line.

Mr. Bull was induced to offer these remarks, for the purpose of recording a practice he had successfully applied to the protection of river banks (of which he presented drawings) and his opinion as to its applicability to the construction of breakwaters.

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## "*Description of the Menai Lighthouse.*"
## *By D. P. Hewett, Grad. Inst. C. E.*

The Menai Strait is peculiarly fitted for a harbour of refuge for vessels entering the Rivers Dee and Mersey from the north, and the increasing number of ships frequenting this navigation, as well as the insufficiency of its beaconage, rendered it desirable that the entrance should be distinctly marked; the Corporation of the Trinity House accordingly decided, in 1834, to effect this object by the construction of a lighthouse, to be situated on a sunken rock about 250 yards from the Anglesey coast on the west side of the entrance, which is divided by the Puffin Island into two channels, defined by a beacon and two buoys.

The principal novelty in the construction of the lighthouse is the base, which, instead of diminishing, like the Eddystone, with a regular curve, recedes by a series of rectangular offsets; the object of this form of structure is to break the force of an impinging wave, and prevent the whole effect of its shock being thrown upon the upper part of the building, as it is when guided up by the curved surface.

The building, which was designed by Messrs. Walker and Burges, is a handsome circular tower 75 feet high, 40 feet in diameter at the base, and 20 feet 6 inches diameter at the top, terminated by a castellated parapet, and entirely constructed of Anglesey marble. The base of the building is solid to the height of 22 feet 6 inches from the rock, diminishing at intervals of 2 feet 3 inches by offsets of 9 inches each, up to 6 feet 9 inches above high-water mark, where its diameter is 22 feet. On that level is the entrance doorway (which is accessible by steps cut in the base stones). The interior contains six floors, forming rooms for the uses of the light-keepers, stores, &c. Every precaution has been taken to render the exterior joints of the courses water-tight; each stone is secured to that below it by a slate joggle, and two oak trenails, passing entirely through it, and entering 8 inches into the lower stone. On the upper bed of each course of stones is a projecting fillet, which fits into a corresponding groove in the under side of the course placed upon it, in order to prevent the water from being forced between the courses. The two upper courses project internally and externally to form a gallery which supports the parapet and the lantern, the foundation and the framing of which are of cast-iron. The wall diminishes gradually in thickness from 6 feet 9 inches to 2 feet.

The communication describes minutely the construction of the floors, the partitions, the stairs, the lanterns, &c., and the proportions of the materials for the mortar, which consisted of three measures of sand, one of ground lime, and one of Italian pozzuolana.

The light is a stationary, red, dioptric light of the first order, without mirrors. The burner consists of four concentric wicks, of which the largest is 3½ inches diameter; its ordinary consumption of oil is one pint per hour. The various bearings are given from which the light is visible at sea. After deducting all expenses, the surpluss revenue derived from the light dues, during the year 1840, is stated to have been 388*l.* 13*s.* 3*d.*

The lighthouse is connected with the shore by a foot bridge, which consists of a platform 2 feet 3 inches wide, supported upon a series of iron columns placed 10 feet apart, secured into the rock and strengthened by stays. This slight construction has withstood the violence of the waves for three years.

The paper notices the buildings which have been erected on the shore for the residence of the light-keepers, and then proceeds to describe the beacon before alluded to, which points out a dangerous ledge of rocks on the opposite side of the channel. It consists of a cone of masonry, 20 feet in diameter at the base, and 37 feet high, surmounted by a staff and globe rising 13 feet above the apex of the cone. The globe, which is 4 feet diameter, is formed of copper bands, and is 36 feet above high-water mark.

The whole amount expended in these different constructions is stated to have been about £12,800.

The communication was illustrated by a series of detailed drawings and a chart of the straits.

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April 19, 1842.

"*On the causes of accumulation of deposit in Sewers, and on the hitherto generally prevalent mode of removing the same; with a description of a new Flushing Apparatus used for cleansing the Sewers in the Holborn and Finsbury Divisions.*" *By John Roe, Assoc. Inst. C. E.*

In the Holborn and Finsbury Divisions there are upwards of eighty miles of covered sewers, in a large proportion of which there were accumulations of deposit, which by choking the side drains and causing effluvia became sources of much annoyance. The only remedy resorted to, was to raise the deposit to the surface of the street and cart it away: this was for many reasons an objectionable process, and a careful examination of the sewers was ordered, when it was found that many causes of obstruction existed. In sewers of the same form and inclination, different degrees of accumulation existed: this was caused sometimes by a greater run of water in one than in the other: in other cases, although the flow of water was equal, the deposit was unequal: in some situations, openings having been made to insert side drains, bricks had been left in the sewer, against which considerable deposits had formed: the admission of water from collateral sewers at right angles and at different levels had also caused obstructions to the continuous flow along the main line: an example is given, where, although the collateral sewer was 3 feet above the level of the main line, a deposit of a foot in depth was formed for several hundred feet up the stream, while below the point of junction the sewer was perfectly clear. The insertion

of gully-necks frequently caused obstructions by permitting the access of dirt and rubbish from the road.

These facts being ascertained, the next consideration was how to remedy the defects, as the locality would not permit an alteration of level, which would give a flow through the sewers sufficiently strong to carry off the deposit. After a long series of experiments (by the author, who is engineer to the Commissioners) and trials upon several kinds of apparatus, an arrangement was decided upon, consisting of an iron frame set in the sewer with a hinged door half its height, fitting with a water-tight joint: it is opened and closed by means of a jointed rod, which is worked from the level of the street. A head of water is allowed to collect against the closed door until it is sufficiently heavy, when the door being suddenly opened, the whole mass of deposit is carried forward by the rush of water. The operation is repeated with a head of 3 feet of water at intervals of half a mile, until the whole of the accumulation issues at the outfall, thoroughly cleansing the sewer. After this arrangement of apparatus had been some time in use, an improved form, with a side entrance, was continued, and is now generally adopted in situations which admit of it.

By this simplified arrangement the stopgate can be worked without the mechanical contrivances of the other method, and an easy access is afforded to the sewers. This latter mode is generally adopted, and the success of the plan is stated to be perfect.

All the details of the construction of the stop-gates and the sewers, as well as of several improvements in the building of the gully-holes and collateral sewers, are given, with the result of the velocities of the currents of water from heads of various heights. Drawings of all the several kinds of apparatus invented by the author were presented, and the models which were exhibited were explained by Mr. Burton, the manufacturer of the flushing apparatus.

*Indicators for Steam-Engines.*

Mr. Farey exhibited and described one of a set of Indicators for steam-engines, made by Mr. Penn of Greenwich for the French Government, to be used in trying experiments on the steam vessels in their navy.

The construction was the same as those made by Mr. M'Naught of Glasgow; but the instruments were larger and better proportioned. Mr. Farey availed himself of the opportunity of describing the construction, the operation of, and the qualities required in a good Indicator, and then exhibited a series of Indicator cards, either taken by himself or by friends whose accuracy could be depended upon. They extended from the year 1817 at short intervals down to the present time, and showed a great improvement in the application of steam in engines: in fact, Mr. Farey was of opinion that the origin and progress of the modern improvements in engines might be traced by a series of cards carefully taken at various periods, and he promised to contribute a more extended communication on the subject during the ensuing session.

April 26, 1842.

"*Description of a new arrangement for raising Ships of all classes out of water for repair; proposed to replace the Graving-Dock or the Patent Slip in certain situations; with observations upon the other methods used at different periods for this purpose.*" *By Robert Mallet, M. Inst. C.E.*

This communication describes an apparatus proposed by the author as a substitute for the graving-dock or the patent slip, in situations where such constructions would be too expensive, or an inappropriate locality prevents their adoption. It reviews the principal methods hitherto in use,—such as stranding by bilge-ways, careening or heeling over, lifting by the camel, the graving-dock, the floating-dock or caissoon, the screw and the hydraulic docks (both American inventions), and Morton's patent slip: it enumerates the localities for which each of these inventions is most applicable, and then gives the objections to them. The author then describes the general principle of his invention to be, the diffusion of the load or strain over the greatest possible number of fixed points, avoiding casual and unequal strains; that there should be uniform motion, with a power proportioned to the resistance. In providing for this, the toggle-joint is used throughout. The machine consists of a platform, supported upon a series of frames with joints at each end, attached at the lower extremities to fixed points in the foundation, and at the upper ends to the under side of the platform, which is traversed by a series of beams, to the ends of which are fastened rods connected with rollers, working in grooves along a suspended railway on the cantilevers of two jetties, which are built to form the sides of the apparatus. A chain connected with all these rollers traverses in each suspended railway groove, and the power of a steam-engine and wheel-work being applied after the vessel is floated on the platform and made fast, the frames raise the platform and vessel together gradually out of the water, permitting free access all

round the ship; and when the repairs are completed, the whole is again lowered into the water. It is contended that many practical advantages would arise from this system,—that the ship would not be strained,—that time would be gained, and that it is superior to the ordinary methods now practised.

The calculations of the leverage, the division of the load over the fixed points, &c., are given in detail, and the paper is illustrated by a series of elaborate drawings and a complete model of the apparatus.

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Mr. Rendel thought that credit was due to Mr. Mallet for the science and the practical skill combined in the production of the contrivance under discussion; it was perhaps imperfect in some of the details, but he was inclined to believe that, in certain situations, and for vessels of moderate size, it might be adopted. Its construction would certainly be more expensive than that of a patent slip; but it would be less costly than a graving-dock, and not liable to injury from hydrostatic pressure, to guard against which frequently constituted a main portion of the expense of a graving-dock. The foundation of this structure might be simple, as the weight was distributed over so many points: he conceived, however, that unless it was established where the rise of tide was considerable, the foundations must be laid at a depth of 5 or 6 feet under low-water mark, to allow for the thickness of the frames and the platform beneath the ship's bottom. He was of opinion that a modification of the plan might be advantageously employed for canal lifts.

Mr. Hawkins agreed with Mr. Mallet that a ship must be strained while on a patent slip, because the timbers were all bearing a weight at an angle: but more particularly when leaving the slip, as the stern floated whilst the stem was still on the cradle of the slip.

Mr. Palmer did not admit the advantages of the proposed plan over graving-docks, for, as they are now constructed, they possess every requisite convenience for examining and repairing vessels: the gates are made to exclude the water perfectly, and the machinery for pumping is so effective, that a very short time suffices to lay the dock dry. The plan might possess some advantage over Morton's slip in retaining the vessel in a vertical position, but it would be more expensive to construct, and he was not at all convinced that the objections urged against the patent slip were well founded.

Mr. Gordon observed that the position of a ship upon a patent slip was exactly that in which it was built; he could not therefore understand why it should be so very injurious; besides, if the stern cradles were elevated, as was the case on some of the slips proposed by Captain Brown, the vessel remained nearly on an even keel. Another improvement introduced by Captain Brown was, substituting solid rollers for the wheels of Morton's slip, the axles of which frequently twisted and prevented the progress of the vessel.

Among the modes of examining the bottoms of vessels enumerated by Mr. Mallet, he had omitted the "gridiron," which consisted of a strong frame of horizontal timbers resting upon the heads of piles a little above low-water mark; over this frame the vessel was moored, and on the tide receding was shored up, resting upon chocks. When it was dry the bottom could be examined, and any slight repair made before the returning tide floated the ship off. "Gridirons" existed at Liverpool, at Hâvre, and at many other ports.

The President observed, that, like the form of breakwaters, much depended upon locality. Where timber was cheap, and the rise of tide considerable, the plan might be applicable; at Liverpool, where the tide rose 30 feet, and in the Channel Islands, where the rise was 40 feet, the platform might be 10 feet above low-water mark, and still accommodate any ordinary vessel. It certainly appeared to avoid some of the main expenses of the graving-dock, in which so many precautions must be taken for preventing the springs rising and blowing up the bottom. The Institution was much indebted to Mr. Mallet for the great pains he had bestowed on the communication, for the complete drawings and model illustrating it (which were presented to the Institution), and he deserved credit for the ingenuity displayed in the contrivance.

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"*Account of the Machinery and Apparatus for compressing and using Gas for Artificial Illumination at the Portable Gasworks of London, Edinburgh, Manchester, and Paris.*" *By Charles Denroche, Grad. Inst. C.E.*

This paper gives an account of the improvements introduced by Mr. David Gordon into the syphon forcing-pumps, reservoirs, &c., whereby the requisite degree of compression was obtained for rendering gas portable for the purposes of illumination, and of the arrangements adopted in the works at Edinburgh, Manchester, London, and Paris. A description is given of the various kinds of apparatus which were tried before a pressure could be obtained of 30 atmospheres, or 450 lbs. per square inch. The portable

lamps with their ingeniously contrived graduated cocks are also described, with the several parts composing the apparatus. It appears that, owing to the cost of compression, which was three shillings and sixpence per thousand cubic feet, and that of delivery, which amounted to ten shillings per thousand feet, the speculation was unsuccessful in a mercantile point of view, although most of the mechanical difficulties were overcome.

The paper was accompanied by a series of detailed drawings of every part of the apparatus.

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May 3, 1842.

"*Description of the Tunnels, situated between Bristol and Bath, on the Great Western Railway, with the methods adopted for executing the works.*" *By Charles Nixon, Assoc. Inst. C.E.*

The works described in this paper comprised a large quantity of heavy earth-work in tunnels, &c.; they were commenced in the spring of the year 1836, and terminated in the year 1840. The whole of the tunnels are 30 feet in height from the line of rails, and 30 feet in width; they are curved to a radius of about 120 chains; the gradient of that part of the line is 4 feet per mile. The strata through which they were driven consisted generally of hard gray sandstone and shale, with the gray and dun shiver, &c.; in a few places only, the new red sandstone and red marl were traversed. Every precaution was taken for securing the roofs, by lining them with masonry where the nature of the strata demanded it, and in some places invert arches were turned beneath.

Driftways were driven before the tunnels were commenced, and shafts were sunk to enable the work to proceed at several points simultaneously. The modes of conducting the works by these means are fully described, with all the difficulties that were encountered. The construction of the centres is given, with the manner of lining the arches with masonry, which is stated to be what was termed "coursed rubble;" but was of a very superior description, and in every respect similar to ashlar-work.

The author offers some remarks with regard to the expense of working tunnels by means of centre driftways. He states this plan to be costly, and in many instances without corresponding advantages, on account of the difficulty of keeping the road clear for the wagons. He recommends that when driftways are used they should be on the lower side of the dip of the strata, as the excavation would be facilitated, and the road would be kept clearer. In long tunnels he has found the cheapest and most expeditious mode of working to be by excavating the centre part from shafts, and both the ends (together if possible) from the extremities after the open cuttings are made. The drawing accompanying the paper gave a longitudinal section of all the tunnels, and showed to an enlarged scale several transverse sections of them, where the variations of the strata rendered either partial or entire lining necessary.

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In answer to questions from Mr. Vignoles and other members, Mr. Nixon explained that the extra number of shafts had been required in order to enable the works to be completed within a given time: there had not been any accidents during his superintendence, but subsequently one of the shafts had collapsed. The cost of driving the driftways, the dimensions of which were 7 feet wide by 8 feet high, was ten guineas per yard lineal. He then described more fully his proposed plan of cutting the driftways on the lower side, instead of the centre of the tunnel, and stated the advantages chiefly to consist of a saving in labour and gunpowder, as a small charge sufficed to lift a considerable mass of rock when acting from the dip: the road was also less liable to be closed by the materials falling into it when the enlarged excavation proceeded from one side instead of upon both sides.

Dr. Buckland, after returning thanks for his election as an honorary member of the Institution, expressed his gratification at the prospect of a more intimate union between engineering and geology, which could not fail to be mutually beneficial, and cited examples of this useful co-operation in the cases of railway sections, and models that had recently been furnished by Engineers to the Museum of Economic Geology.

He then proceeded to remark upon the geological features of the South-Western Coal-Field near Bristol and Bath, which had been described by Mr. Conybeare and himself, in the Transactions of the Geological Society of London (1824).

Some of the tunnels near Bristol are driven in the Pennant Grit of the coal formation, where it is thrown up at a considerable angle, and composed of strata yielding slabs and blocks of hard sandstone used extensively for pavement.

In traversing such inclined and dislocated strata, the engineer's attention should, he conceived, be especially directed to the original joints that intersect the beds nearly at right angles to their planes of stratification, and also to the fractures produced during the movements they have undergone. These natural divisions and partings render such inclined stratified rocks unworthy of confi-

dence in the roof of any large tunnel, and liable to have masses suddenly detached.

Inclined strata of a similar sandstone are perforated by many tunnels on the railway near Liège, in nearly all of which the roofs are supported by brick arches.

It has been found impossible to make the tunnels through lias and red marl without continuous arches of masonry.

In any of the tunnels which have been carried through strata of the great oolite, the parts left unsupported by masonry would, in his opinion, be peculiarly liable to danger, because even the most compact bed of oolite are intersected at irregular intervals by loose joints at right angles to the planes of the strata, and occasionally by open cracks; and it is to be feared that the vibration caused by the railway carriages would tend eventually to loosen and detach these masses of stone.

He apprehended still greater danger would exist in tunnels cut through the loosely jointed strata of chalk, unless they are lined throughout with strong masonry; and even that, in a recent case, had been burst through by the weight of the incumbent loose chalk coming suddenly upon the arch.

In open cuttings though chalk, where the numerous interstices and the absence of alternating clay-beds prevent any accumulation of water, there is little chance of such frequent landslips as occur where beds of stone, gravel, or sand rest on beds of clay; but until the side walls of chalk are reduced to a slope at which grass will grow, they will be subject to continual crumblings and the falling down of small fragments, severed by the continual expansion and contraction of the chalk, under the destructive force of atmospheric agents, and chiefly of frost.

In open cuttings, where the inclination of the strata is towards the line of rails, the slope should be made at a greater angle than if the strata inclined from the rails; if this be done, fewer landslips will occur from accumulations of water between the strata thus inclined towards the rails; and such slips may be further guarded against by minute and careful observation of the nature of the individual strata, and a scientific application of subterranean drains at the contact of each permeable stratum with a subjacent bed of clay.

Tunnels can be safely formed without masonry in unstratified rocks of hard granite, porphyry, trap, &c., and in compact slate rocks; also in masses of tufa, such as cover Herculaneum, and are pierced by the grotto of Pausilippo near Naples: but, in his opinion, wide tunnels driven in stratified rock could not be considered secure unless they were supported by arches.

Mr. Sopwith confirmed the remarks on the importance to the Civil Engineer of a knowledge of the geological character of the strata through which tunnels or open cuttings were to be made: the cost was materially affected, as well as the stability of the works. The angle of inclination and the lines of cleavage should be carefully studied: on one side of a cutting the slope might be left steep, and all would be firm and dry; whilst on the other, if the same slope was adopted, all would appear disintegrated and wet, and a series of accidents would be the necessary consequence. He could not sufficiently urge the importance of a more intimate connexion between the Geologist and the Engineer.

In answer to a remark by Mr. Farey on the apparent advantages of Frazer's Centres for Tunnelling, Mr. Bull promised to promised to procure for the Institution an account of the execution of some work with them.

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"*An account of the Railroad constructing between Liege and Verviers, Belgium.*" *By Lieutenant Oldfield, Assoc. Inst. C. E.*

The materials for this communication were drawn from the memoranda made during a tour by the author, who is an engineer officer in the service of the East India Company.

It describes the general course of the railway, descending by the long inclined planes, from the height above Liege to the valley of the Meuse, its progress along the banks of the Vesdre, through tunnels, and over almost innumerable bridges and viaducts, to Chaudfontaine, and thence onward through the town of Verviers, in the direction of Aix-la-Chapelle, to the frontiers of Germany. The modes of excavating the tunnels, and the materials used in the other works on the line, are accurately described; the general acclivities and curves of the road, the rails, chairs, and methods of fastening them to the sleepers, and the prices of labour and materials, are all given in detail, and the whole was illustrated by enlarged diagrams from the author's sketches.

## THE HAND-BOOK OF MANCHESTER.*

The state of our great manufacturing metropolis, Manchester,—at all times an object of lively interest,—derives from

* "The Hand Book of Manchester; containing Statistical and General Information on the Trade, Social Condition, and Institutions of the Metropolis of Manufactures." By B. Love, Member of the Literary and Philosophical Society of Manchester. 296 pp., 12mo. Love and Barton, Manchester; Hamilton and Co., London.

the passing events of the day a degree of importance, which cannot be truly described as otherwise than most portentous and melancholy. At no moment, perhaps, could a work like that before us have made its appearance, with so great a certainty of being caught up and read with avidity. It is not, indeed, quite a new book, for it is only a second edition of a work which appeared two or three years ago under the title of "Manchester as it is;" and was favourably noticed by us at the time; but it has been so much enlarged, and altogether so much improved, that it is, as the saying is, as good as new. The chief additions made to the work relate to that which is now uppermost in all men's minds,—the condition of the operative and middle classes of Manchester. The information given under this head has been collected with a great deal of care, and is exceedingly interesting and instructive. As our proper business, however, is less with the social evils of the community, than with their progress in mechanical improvements, we prefer giving, as a specimen of the style of the work, the following exemplification of the

*Effect of Strikes in stimulating Invention.*

"Occasionally, a *strike* proves to the unionists a permanent loss of employment Such an instance occurred in the extensive works of Mr. Fairbairn, engineer, of this town. Some time ago about fifty boiler makers were employed by Mr. Fairbairn. They 'struck,' because their employer infringed, as they considered, upon their privileges, by introducing a few labourers, not in 'The Union,' to perform the drudgery connected with the work. On this, Mr. Fairbairn and Mr. Robert Smith invented a machine which superseded the labour of forty-five out of the fifty of his boiler makers. The work is performed by the machine much quicker, and more systematically, than it was by manual labour.

"Here is an example of an invention resulting entirely from necessity. Here, also, is a practical example of the results of a strike. The self-acting mule was invented under similar circumstances. Still, experience does not seem to teach operatives the wisdom of allowing trade to be open, and masters and men to be unrestricted in their operations. Perhaps nothing has contributed more to exalt the inventive genius of our mechanical men and engineers, than the unsufferable annoyances to which they have been subjected by trades' unions. The folly of working men,—to reduce the talented and unskilful, the idle and the industrious artizan, to one common level; and to insist that the veriest dolt that ever stumbled through his apprenticeship, shall rank with the intelligent and diligent,—is of an extreme character, and unworthy this age of the '*diffusion of knowledge*.'"

The author's notice of the Bleaching and Calico Printing Works of Manchester is also well worth quotation, more especially for the hint which it contains of the inutility of mere skill in designing, unless combined with a considerable share of chemical knowledge.

*Bleaching and Calico-Printing Works.*

"With bleaching the name of the late Dr. Henry's father must ever be associated. He was the first who introduced into Manchester the discovery made by a French chemist, of the uses of oxymuriatic acid and chlorine, in whitening cloth—'a discovery which soon led to a complete revolution in the trade of this town and neighbourhood.' The arts of dyeing and calico printing have received great assistance from such men of science as Drs. Dalton, Warwick (the inventor of the colour called 'warwick green,') and Henry; and Messrs. Davies, Thompson, Mercer, and others, including Berthollet, the celebrated French chemist; and in most of the establishments in which these arts are wrought out, some one or more of the principals are, practically, men of eminent scientific talent; in fact, it is almost indispensable that they should be, in order that the trades may be rendered profitable. In connexion with calico printing, it may be observed, that many persons earn large sums by *designing* new patterns for this branch of trade. Such persons need to possess a knowledge of chemistry, or they may spend much labour in vain. It is an easy matter to depict beautiful patterns; but unless the colours which they may contain be arranged according to chemical principles, *to work* the designs would be impracticable. To talented designers, high prices are paid for patterns. Many persons gain a livelihood by importing from France, the moment they make their appearance, small pieces of the newest patterns of prints. These they offer to the calico printers, who usually purchase them at high rates."

The engravings, which in the original edition were outline sketches merely, are now in the first style of the graphic art. A very striking portrait has been added, of the illustrious Dalton, the most eminent of all the worthies of Manchester, living or departed. It is stated to be

from an original drawing by Mr. Stephenson, a Manchester artist of high local reputation.

The "Hand-book of Manchester" is, on the whole, in every way worthy of its subject, and well merits what it cannot fail to command—a very extensive circulation.

## PIRACY OF DESIGNS.

### *Worship-street Police Office.* 24th August, 1842. *(Before Mr. Bingham.)*

In our Magazine of the 13th inst. we gave a report of some proceedings which had taken place before the City Magistrates, on the complaint of Messrs. Kipling, carpet manufacturers, against Mr. Johnson, of Bow-lane, for piracy of certain registered designs. In consequence of the technical objection then successfully taken, that the defendant, though he was a warehouseman in the City, does not *reside* there, and was therefore not within the jurisdiction of the City Magistrates, the case was now brought before Mr. Bingham, the Police Magistrate of the Worship-street division, which comprehends Finsbury-square, where Mr. Johnson lives.

The defendant was charged with publishing and disposing of for profit, without the license or consent of the complainants, a certain article of manufacture called carpet, wherein had been used an original part design made for the pattern of the said carpet, whereof the complainants are the registered proprietors.

Mr. Joseph Rothery, agent to Messrs. Kipling and Co., proved that on the 15th of March he registered for them two new patterns of carpets now produced, and he produced the certificates of registration. The pieces of carpets sold by the defendant and now shown, were copies of the original registered pattern with some little variation.

When cross-examined by Mr. Chambers, he said that the drawing now pointed out was what was technically called "the design," and its combination with the other parts constituted the finished and original pattern. A piece of floor-cloth being now shown to him, he said the figures in it had some resemblance to the registered design, but there was a difference in the filling up, such as the substitution of a line for a diamond, and so on.

Mr. Henry Ridley Ellington, manager of complainants' business in Newgate-street, proved, that on the 15th of July he went to Mr. Johnson's place at Finsbury-square, and purchased the produced pieces of carpet. The defendant, in answer to his observations respecting them, said that he conceived he had a right to sell them without reference to their being registered.

The registered patterns of the complainants being compared in court with those sold by the defendant, it was evident that the latter contained the principal figures of the former, with some little variation in the filling up.

The counsel for the defendant contended that there was no case produced upon which he could be convicted under the statute.

Mr. Bingham, in giving his judgment, said, that his opinion upon the evidence he had heard was, that the design of the carpet produced by the complainants, was an original design, that the one sold by the defendant was a copy, and that he sold it knowing that no consent had been given. Upon all the points it was a case within the meaning of the act, which rendered the defendant liable to a penalty of from 5*l*. to 30*l*.

The defendant was ordered to pay a penalty of 5*l*. and the costs.

## LIST OF DESIGNS REGISTERED BETWEEN JULY 28TH, AND AUGUST 25TH, 1842.

| Date of Registration. | Number in the Register. | Registered Proprietors' Names. | Subject of Design. | Time for which protection is granted. |
|---|---|---|---|---|
| July 28 | 1381 | R. Bull | Chimney shield, or return smoke preventer | 3 |
| " | 1382 | A. Shanks | Slide-rest | 3 |
| 29 | 1383 | J. Addenbrooke | Envelope | 1 |
| " | 1384 | Benjamin Perkins | Plate-warmer | 3 |
| Aug. 1 | 1385 | Knight and Sons | Standard for scales | 3 |
| " | 1386,7 | Dobson and Son | Carpet | 1 |
| " | 1388 | Horwood and Monkman | Self-acting lubricator | 3 |
| 2 | 1389 | Woodward and Co. | Carpet | 1 |
| 3 | 1390 | Mordan and Co. | A case for pencils or tooth-picks | 3 |
| " | 1391 | William Dugard | Gas-reflector | 3 |
| " | 1392 | F. Barber | Book-opener | 3 |
| 4 | 1393 | Samuel Bennett | A set square | 1 |
| " | 1394 | Shoolbred, Loveridge and Shoolbred | Handle | 3 |
| " | 1395 | Isaac Brown | Portable apparatus for weighing coin | 3 |
| 8 | 1396 | Samuel Ackroyd | Stove | 3 |
| " | 1397 | James Barlow | Portable oven, with spit | 3 |
| 9 | 1398 | Joseph Gillott | Pen-holder | 3 |
| " | 1399 | George Scott | Spiral brush | 1 |
| " | 1400 | Deane Samuel Walker | Edge-bound band for machinery | 1 |
| 11 | 1401 | Charles Wheeler | A frictionless pump | 3 |
| 12 | 1402 | Abraham Evans | Grease cock, for lubricating machinery | 3 |
| " | 1403 | G. P. Bayly | Tooth brush | 1 |
| 15 | 1404 | Alexander Miller | Harness | 3 |
| 16 | 1405 | Jeffery Shore | Pot or scuttle lifter | 3 |
| " | 1406 | S. B. Palmer | Economic steam cooking apparatus | 3 |
| 17 | 1407 | Barrett and Ashton | Coulter for ploughs | 3 |
| 19 | 1408 | Charles Ellis | Coach-door plate | 3 |
| " | 1409 | James Yates | Umbrella-stand | 3 |
| " | 1410 | William Thorold | Improved horse-mill | 3 |
| " | 1411 | Unwin and Rogers | Knife and pencil case | 3 |
| 22 | 1412 | Roberts and Mettam | Pocket-comb | 1 |
| " | 1413 | Ditto ditto | Umbrella-handle | 3 |
| 23 | 1414,15 | S. Beckhams | Pen | 3 |
| " | 1416 | H. A. Sanders | Envelope | 1 |
| 25 | 1417 | G. M. Braithwaite | Chimney-cap | 3 |

[AGENTS FOR EFFECTING REGISTRATIONS, MESSRS. ROBERTSON AND CO., 166, FLEET-STREET.]

## LIST OF ENGLISH PATENTS GRANTED BETWEEN THE 29TH OF JULY, 1842, AND THE 25TH OF AUGUST, 1842.

Thomas Bell, of Saint Anstill, Cornwall, mine agent, for improvements in the manufacture of copper. July 29; six months.

Jules Lejeune, of Regent's park, engineer, for improvements in accelerating combustion, which improvements may be applied in place of the blowing machines now in use. July 29; six months.

John Stephen Woolrich, of Birmingham, chemist, for improvements in coating with metal the surface of articles formed of metal or metallic alloys. August 1; six months.

Alfred John Phipps, of Blackfriars-road, gentleman, for certain improvements in paving streets, roads, and ways. August 1; six months.

Joseph Whitworth, of Manchester, engineer, for certain improvements in machinery or apparatus for cleaning roads, and which machinery is also applicable to other similar purposes. August 2; six months.

John Dry, of Beverley, agricultural implement maker, for certain improvements in thrashing machines. August 2; six months.

Samuel Carson, of Covent Garden, gentleman, for improvements in purifying and preserving animal substances. August 3; six months.

Archibald Turner, of Leicester, manufacturer, for improvements in the manufacture of muffs, tippets, ruffs, mantillas, cloaks, shawls, capes, pellerines, boas, cuffs, slippers, and shoes. August 3; six months.

John Lee, of Bermondsey, gentleman, for improvements in wheels and axle-trees to be used in railways, and in machinery for stopping on, or preventing such carriages from running off railways, which improvements may also be applied to other carriages and machinery. August 3; six months.

Charles Henri Perrin, of Lombard-street, London, for some improvements in the construction of certain parts of the mechanism used in watches and chronometers, which improvements are also applicable to some kinds of clocks. August 8; six months.

David Napier, of Milwall, engineer, for improvements in steam engines and steam boilers. August 9; six months.

Thomas Walker, of Birmingham, stove-maker, for improvements in stoves. August 9; six months.

Richard Ford Sturges, of Birmingham, manufacturer, for a certain improvement in the manufacture of Britannia metal and plated wares. August 10; six months.

Dominic Frick Albert, of Cadishead, Doctor of Laws, manufacturing chemist, for a new combination of materials for the purpose of manufacturing a manuring powder. August 10; six months.

Moses Poole, of Lincoln's Inn, gentleman, for improvements in paving or covering roads and other ways. August 11; six months.

Joseph Betteley, of the Brunswick Anchor Works, Liverpool, chain cable manufacturer, for improvements in windlasses and machinery for moving weights. August 11; six months.

John Thomas Betts, of Smithfield Bars, gentleman, for improvements in covering and stopping the necks of bottles. (Being a communication.) August 11; six months.

George Roberts, of Liverpool Road, miner, for improvements in the construction of lamps. August 15; six months.

William Raybould, of Clerkenwell, brass founder, for a new or improved soldering iron. August 18; two months.

George John Newbery, of Cripplegate-buildings, artist, for certain improvements in producing damask and other surfaces on leather and other fibrous substances and fabrics. August 18; six months.

Nathan Defries, of Fitzroy-square, engineer, and Nathaniel Fortescue Taylor, of Mile End, engineer, for improvements in meters for gas and other fluids. August 18; six months.

William Ridgway, of Stafford, earthenware manufacturer for a new method of conveying and distributing heat in ovens used by manufacturers of china and earthenware, and brick, tile, and quarry makers. August 18; six months.

Goldsworthy Gurney, of Great George-street, gentleman, for certain improvements in apparatus for producing, regulating, and dispersing light and heat. August 18; six months.

Richard Else, of Gray's Inn, Esq., for certain improvements in machinery or apparatus for forcing and raising water and other fluids. August 18; six months.

Thomas Hendry, of Glasgow, mechanic, for certain improvements in machinery for preparing and combing wool, and other fibrous materials. August 25; six months.

David Redmund, of City Road, engineer, for improvements in hinges or apparatus applicable to suspending or closing doors and gates, and other purposes. August 25; six months.

## LIST OF PATENTS GRANTED FOR SCOTLAND FROM 25TH OF JULY TO THE 22ND OF AUGUST, 1842.

William Newton, of Chancery-lane, Middlesex, civil engineer, for certain improved machinery for excavating, dredging, and removing earthy and stony matters in the construction of railroads, canals, cleaning of rivers, harbours, and redeeming marshy or alluvial soils; also for boring rocks, indurated clay, and other earthy matters, for the purpose of blasting and removing the same: the whole to be worked by steam and other power. (Being a communication from abroad.) Sealed July 25.

Thomas Hendry, of Glasgow, Scotland, mechanic, for certain improvements in machinery for preparing and combing wool and other fibrous materials. July 27.

Thomas Waterhouse, of Edgely, Chester, manufacturer, for a certain improvement or improvements in machinery used for carding, drawing, and roving cotton, wool, flax, silk, and other similar fibrous material. July 27.

John Osbaldeston, of Blackburn, Lancaster, metal heald maker, for improvements in looms for weaving. July 29.

William Geeves, of Old Cavendish-street, Middlesex, gentleman, for improvements in machinery for cutting cork. July 29.

John Woodcock, of Manchester, Lancaster, millwright, for certain improvements in the construction of steam-engines. August 1.

Alexander Johnston, of Hillhouse, Edinburgh, esquire, for certain improvements in carriages, which may also be applied to ships' boats, and various other purposes where locomotion is required. August 2.

Julius Seybell, of Golden-square, Westminster, Middlesex, manufacturing chemist, for certain improvements in the manufacture of sulphate of soda and chlorine. August 11.

Benjamin Biram, of Wentworth, York, colliery viewer, for certain improvements in the construction and application of rotary engines. August 11.

Anthony Tielens, of Fenchurch street, London, merchant, for improvements in machinery or apparatus for knitting. (Being a communication from abroad.) August 22.

NOTES AND NOTICES.

*New mode of Recording Scientific Discoveries.*—The following advertisement appears in the *Times*:—"I hereby record the following discovery—viz., that the wavy or zig-zag path of lightning, or the electric spark, is not its true path, but is an optical effect, arising from its being surrounded by a spiral column of condensed air, produced by its violent passage through the same, and analogous to that of the water-spout."

*A Water Masquerade, or Swimming Extraordinary.*—The following account of a recent exhibition on the Spree (a *Grand Spree* it may be fairly called) is given in a letter from Berlin of August 3, quoted in the *Jersey and Guernsey News*, a liberal and remarkably well-informed paper recently started, in a place where a Journal of that description was exceedingly wanted, and where there is apparently more to correct and reform, than in any other portion of Her Majesty's dominions:—"Last week we were witnesses of a spectacle, of which there is scarcely an example in modern times, at least in Germany—a swimming masquerade. This spectacle was given by the pupils of the Royal Swimming School of Berlin, in honour of the 25th anniversary of the establishment, which has formed 23,300 good swimmers. At five o'clock, 1,200 swimmers, for the most part belonging to the army, assembled in the barrack-yard of the infantry of the guard, and proceeded to tents erected on the banks of the Spree, where they put on their costumes. At eight o'clock the following procession was seen to swim forward, and pass before the view of more than 40,000 spectators:—First came a large flat boat, metamorphosed into a large harbour, in which were three bands, who executed morceaux of military music; then, a car, in the shape of a shell, in which was seated Neptune, with his hair and beard of reeds, and armed with his trident. This car was drawn by six dolphins, and surrounded by a band of Nereids and Tritons, the latter playing the trumpet and clashing cymbals. A numerous troop of Indian musicians, bearing on their heads brilliant plumes, adorned with collars and bracelets of coral, and bearing clubs: Scotchmen, Norwegians, Spaniards, Italians, and Russians, in their national costumes. Bacchus, seated on a gigantic cask, crowned with vine-leaves and ivy, brandishing in the air his thyrsus, with which he directed the grotesque evolutions of a hundred bacchants, who sported round his throne; the King of the Frogs, represented by a gigantic frog, seated on a car of reeds, and followed by a train of others of the same species thoughtless in bulk; and, last of all, 200 sailors, singing national songs. The immense crowd who were drawn together by this strange spectacle moved about in carriages on the banks of the Spree, on horseback or on foot, or sailed about in small boats, adorned with garlands of flowers."

The *Chrysotype* is a name given by Sir John Herschell to a new photographic process that he has discovered, and of which he gives the following particulars in the *Athenæum*. "The preparation of the chrysotype paper is as follows:—dissolve 100 grains of crystallized ammonio-citrate of iron in 900 grains of water, and wash over with a soft brush, with this solution, any thin, smooth, even-textured paper. Dry it, and it is ready for use. On this paper a photographic image is very readily impressed: but it is extremely faint, and in many cases quite invisible. To bring out the dormant picture, it must be washed over with a solution of gold in nitro-muriatic acid, exactly neutralized with soda, and so dilute as to be not darker in colour than sherry wine. Immediately the picture appears, but not at first of its full intensity, which requires about a minute or a minute and a half to attain (though, indeed, it continues slowly to darken for a much longer time, but with a loss of distinctness.) When satisfied with the effect, it must be rinsed well two or three times in water (renewing the water,) and dried. In this state it is half-fixed. To fix it completely, pass over it a weak solution of hydriodate of potash, let it rest a minute or two, (especially if the lights are much discoloured by this wash,) then throw it into pure water till all such [illegible] troy the paper."

*Looking a-head!*—We quote the following notice from a Kingston (U. C.) paper. "An iron steamer, for the use of the royal navy on Lake Ontario, has lately arrived out from home. It came, of course, in pieces, but the Government having sent out competent persons, it is to be put up forthwith. In the same vessel which brought out the iron steamer arrived the magnificent engines of the steam frigate *Cherokee*, now almost ready for launching. We have received intelligence on which we can rely, to the effect that the Lords of the Admiralty have determined to put the naval establishment at Point Frederick on a substantial and permanent footing."

*The Penelope Steam Frigate.*—The following are the dimensions of the principal parts of the steam machinery now constructing for the vessel at the Canal Works of Messrs. Seaward and Co.:—Weight of engines, 220 tons; weight of boilers, 95 tons; diameter of cylinder, 91 inches; diameter of paddle-wheel, 30 feet; breadth of paddle-wheel, 10 feet; diameter of paddle-shaft, 17½ inches. She will carry 600 tons of coal, being the average quantity required for thirteen or fourteen days' consumption. The total cost of her engines will be 28,000*l.*, and the exact number of horses' power 625.

*French Steam Marine.*—A vessel called the "Labrador" was launched at Toulon on the 7th inst. She is *to be* fitted with engines of 450 horse power.

*Loading at the Breech.*—Some very successful experiments were made in Woolwich Marshes on Friday (17th inst.) with two 24 pounder guns loaded from the breech, constructed according to a plan invented by Baron Wahrendorff of Stockholm. We quote the following account from the *Times*:—"Eight rounds only were fired at a range of 1,250 yards, four of the shot being covered with a thick kind of serge, and four with lead about two-tenths of an inch thick. The object to be gained by Baron Wahrendorff's invention is to be able to load the guns used on board of vessels at sea from the breech, many valuable lives having been lost during the last war by the difficulty of running out and in the guns when naval engagements took place. The loading at the breech is effected on this plan,—by having the gun bored all through, and after putting in the ball first from the breech end, then the charge of powder, and lastly a chamber amply secured and air tight, that no danger may occur at the rear. The firing was good, the second ball entering the target at the long range of 1,250 yards. The charge of powder was two pounds less on each round, and it was found to give the shot a greater elevation than by the common practice, which was easily accounted for, as the covering of lead gave less windage. It was observed that the shot covered with lead caused a recoil of about a foot more than the recoil of the gun charged with shot covered with serge.

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# Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 995.] SATURDAY, SEPTEMBER 3, 1842. [Price 3*d*.

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## BURBIDGE AND HEALY'S, SYLVESTER COOKING APPARATUS.

Fig. 1.

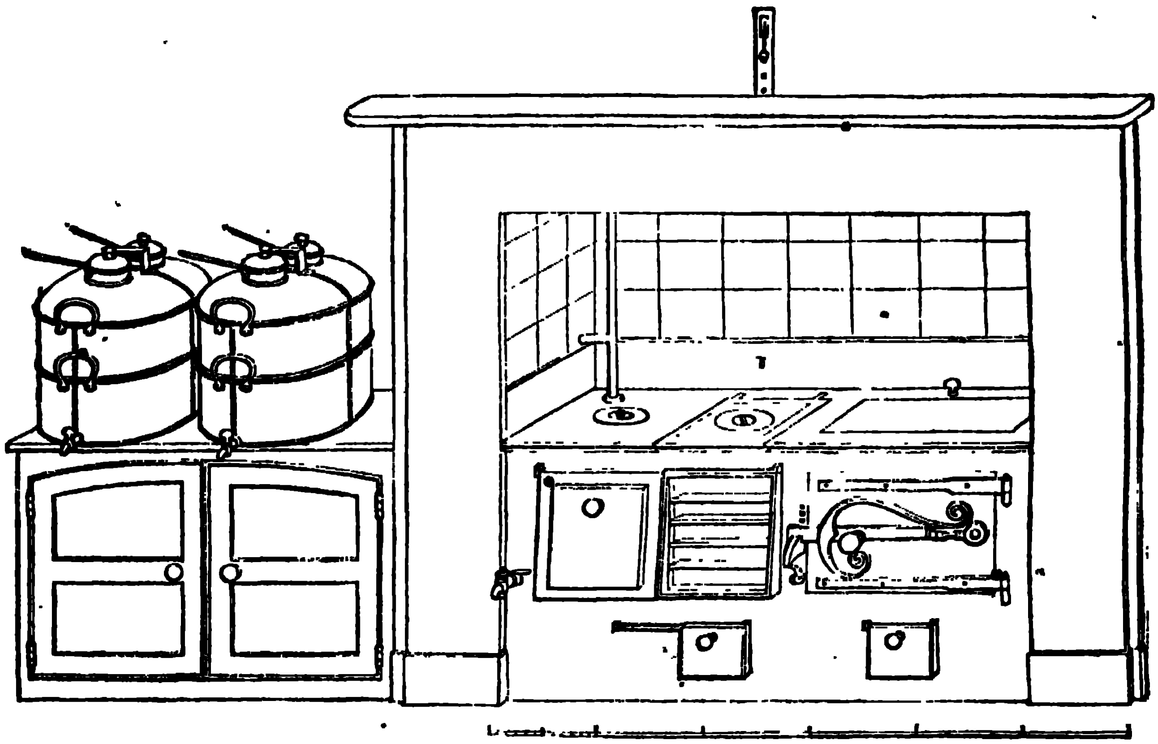
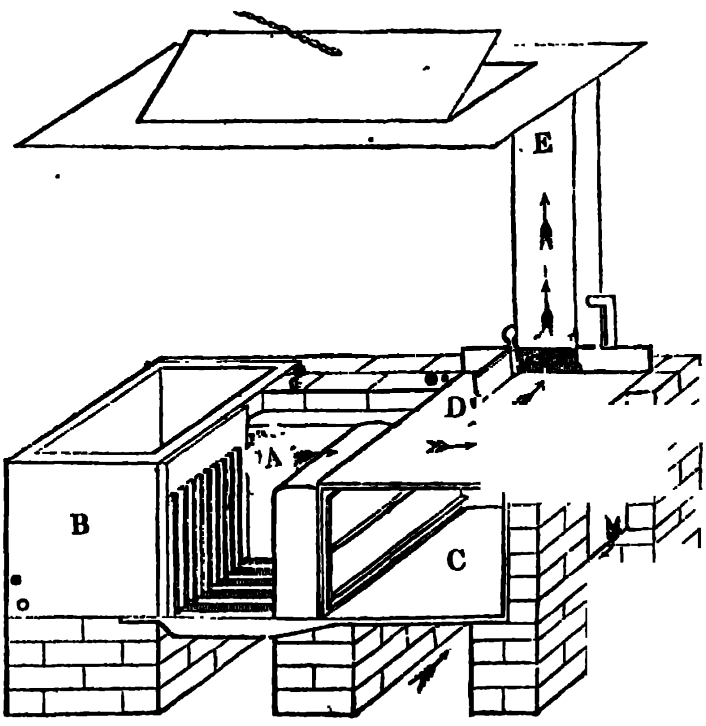


Fig. 2.



## BURBIDGE AND HEALY'S, SYLVESTER COOKING APPARATUS.

The cooking apparatus which we have now to commend to the attention of our readers has been constructed by our respectable neighbours, Messrs. Burbidge and Healy, on the principles developed by Mr. John Sylvester, C. E., so well known for his extensive and successful practice in warming and ventilating buildings, in his work on the "Philosophy of Domestic Economy," and in the specifications of his different patents in relation to heating, (under license, of course, as to the use of these patents, from Mr. Sylvester.) It is an apparatus remarkable at once for its great simplicity, and for performing the offices required of it with the least possible waste of fuel, and with as little inconvenience from the radiation of the heat, to the persons employed in cooking, as the nature of the employment admits of.

Fig. 1 is an elevation of the apparatus, as fixed in its place, and ready for roasting, boiling, stewing, or any other cooking operation; and fig. 2 is a skeleton view, with the external coverings removed.

A is the fire-place, which is closed at top and in front, when boiling or stewing only is going on, but has a door in front, which is opened (as shown in fig. 1) when the fire is required for roasting. B is the boiler, one side only of which is exposed to the fire; but, in consequence of that side being ribbed both inside and outside, in the manner shown in fig. 2, as great a quantity of heat is supposed to be transmitted through that one side, as by any of the large heating surface plans in ordinary use. The ribs of this system are similar to the cylindrical conducting pins employed to such good purpose by Mr. C. W. Williams, in his steam-engine boilers; and exactly the same as a correspondent of ours, (C. W., last vol., p. 106,) proposed to substitute for them—not aware, evidently, that he had been anticipated in the matter by Mr. Sylvester. C is the oven. E, the flue, into which the heated air, vapours, &c., escape after taking the course round the oven indicated by the arrows. D is a door to the flue, which can be shut and opened at pleasure. The bottom of the fire-grate, the bottom of the boiler, and the bottom of the oven are all connected together, so that the heat which concentrated in the fire-place, when the front and flue doors are closed, would destroy or greatly injure the fire-bars, is led off to the oven and boiler, where, if it do not render good service, it can do no harm. The air doors of the fire-place, as well as of the oven, are fitted with non-conducting packings, so that the radiation of heat from them when closed is inconsiderable. Messrs. Burbidge and Healy do not, like a certain Oxford *improver*, whose apparatus we recently noticed, propose such an impracticability as that of roasting without an open fire; but they reduce the inconvenience from that fire to a minimum, by providing for the shutting of it up as soon as the roasting is effected, and excluding radiation afterwards as much as practicable. When the apparatus is not immediately wanted for either roasting or boiling, or any other culinary purpose, the whole of the doors, namely, those of the fire-place, oven, and flue, may be closed, when the fuel left in the grate will still keep ignited, but the process of combustion will go on no faster than in an Arnot's stove. In all kitchen ranges which have no such means as are here provided, of regulating the consumption of fuel according to the occasions of the consumer, the boiler is kept in a constant state of ebullition, evaporating great quantities of water to no purpose, and causing accumulations of sediment, which render frequent scouring out necessary, and are ultimately destructive of the vessel.

The surface of the roasting bars will perhaps strike the reader as being extremely small; but we learn from Messrs. Burbidge and Healy, (at whose manufactory the apparatus may be seen in daily use,) that it has been ascertained by experiment, that an apparatus of the smallest size (3 feet) will roast a joint of 20 lbs., and one of the larger size (6 feet) a joint of any weight not exceeding 40 lbs.

When more than one large joint is required to be roasted at the same time, the additional one may be done in the oven; the current of air passing from the fire-place into the oven and over the meat, having all that peculiar and agreeable effect upon it, which constitutes the difference between roasting and baking.

## MR. SAMUEL HALL'S MODE OF ADMITTING AIR TO FURNACES.

Sir,—Mr. Samuel Hall's plan, by which he proposes to burn coal, instead of coke, in the furnaces of locomotive boilers, having been tried, under his own inspection, on the Liverpool and Manchester Railroad, and having signally failed in producing the desired effects, on which account it was abandoned, after several trials, Mr. Hall being unable to perceive, or point out the causes of such failure, I propose, next week, if possible, or at the first leisure opportunity, to show—1st, That the principle intended to be applied by Mr. Hall, is a direct piracy, and attempted infringement of my patent for introducing air to the combustible gases evolved from coal. 2nd, That manifestly not understanding the principle, as to its chemical bearings, and the conditions on which alone the introduction of such air could be effective in converting such gases into flame rather than smoke, he has so erroneously and unscientifically carried out the principle, (which is, nevertheless, indisputably and chemically correct,) as necessarily to fail in effecting the desired object And, 3rd, That although Mr. Hall affects to introduce *hot air* into the furnaces, the use of hot air being the avowed basis of his patent, he has, nevertheless, introduced *cold* air, of atmospheric temperature, and nothing else.

Having personally examined the application of the principle of introducing air to the furnace and fire-box of the locomotive boiler on the Liverpool and Manchester Railroad, and having noticed the manifest chemical errors committed by Mr. Hall in that instance, I am in a position to speak positively on the subject, and point out those errors. This I deem it the more necessary to do, lest the principle, hitherto so neglected by all writers on the practical details of the furnace, might suffer under the unskilful and (as I consider them) piratical efforts of Mr. Hall; and as presenting a glaring and remarkable instance of the errors and disappointments into which even experienced, ingenious, and observant men may fall, when attempting to carry out a complicated chemical process, as combustion avowedly is, by mere reference to mechanical considerations and proportions, and without a correct and accurate acquaintance with the conditions, on which heat is chemically and electrically evolved under that difficult process.

On this head, also, I am in a position of more experience than most others, having witnessed many failures in effecting perfect combustion in furnaces by reason of the neglect, or omission of some one or more of the essential conditions which nature demands, and chemistry points out, while, at the same time the operators, from ignorance of the necessary chemical details, believed they were conforming to all the essentials of the process. Many indeed, while professedly they were adopting the true principles on which alone air can be admitted to furnaces to produce the desired effect, remained so wedded to certain conditions, proportions and details, which, in their wisdom, they believed would assist nature in her developments, as actually to mar, and even counteract these developments. Mr. Hall's late notable attempt to introduce hot air to the furnaces of locomotive boilers, as a means by which coal may be used in place of coke, may be taken as an illustration of this blundering practice; and under which I am myself a sufferer, and the public interests injured, from the doubt and uncertainty which such failures produce in the minds of inexperienced, though well-disposed men. I am, yours, &c.

C. W. WILLIAMS.

Liverpool, August 23, 1842.

## MR. SAMUEL HALL'S SMOKE BURNER.

*Report by Mr. Josiah Kearsley, Engineer of the Midland Counties Railway.*

To the Committee of Management.

Gentlemen,—In compliance with your resolution of the 20th of June last, that I should report to you my opinion respecting Mr. Hall's offer of the use of his apparatus for burning coal in our locomotive engines, I desire in the first place to refer you to my report of the 3rd January last, in which, after describing the experiments which had been made with the "BEE" engine, I stated that a gross reduction of expenditure from the use of coal is thence evident, "*provided* the action of the fire and the great body of gaseous matter generated and ignited by the apparatus, in the different parts of the boiler and engine exposed to it, be not so prejudicial as to counteract the saving in fuel by increased wear and tear."

I then proceeded to remark, that, "time and hard work alone can give practical proof on this point;" and I added, that "the

application of the apparatus to the "WOLF," which, when finished, will be much more complete than the "BEE," will afford ample opportunity of testing the matter, and give convincing and unquestionable proof whether or not I shall be justified in sanctioning its more general adoption :" and indicate, "whether the great *apparent* advantage in the use of coal is nominal, or virtual," and enable me "to give you a decided opinion whether it will be to the interest of the company to proceed to its general adoption."

The application of the apparatus to the "WOLF" engine, here adverted to, having been since completed, I have been enabled to make the further experiments I then contemplated with this engine on the comparative effects of each description of fuel, when placed on regular traffic, and the result, as it will be my duty to show you, is not satisfactory as regards the use of coal; the "advantage" resulting from the former trials having proved to be "*apparent*" only, or, as I otherwise expressed it, "*nominal*," not "*virtual*."

Before entering into the detail of these experiments, it will be proper I should state, that the apparatus as applied to the "WOLF" engine was fully approved of by Mr. Hall in every respect, and was made as complete and efficient as he conceived it possible to be.

The course of experiment I adopted in each case was to run the engine 1500 miles, at the rate of 100 miles per day, with our special goods' train, this being the most regular and best adapted to give a correct result. The quantity of coal consumed was at the rate of 65 pounds per mile, or 9·1 ounces per ton per mile, for the gross load moved, and at a cost of £21 17*s.* which, added to the drivers' wages and other working expenses, (exclusive of repairs) gave an amount of £46 6*s.* 10*d.* but with the addition of repairs undergone during and subsequent to the experiment, by running the above distance, was £81 14*s.* 6*d.*, or on an average of 12½*d.* per mile. The rapidly destructive effect of the flame from the coal caused a delay of several days, not only during the progress of the experiment, but afterwards, before the engine could proceed to work with coke.

When these repairs were completed, she was again placed on precisely the same duty as in the experiment with coal, and kept in constant daily work for the same distance, namely, 1500 miles. The quantity of coke consumed was at the rate of 53 pounds per mile for the gross load moved, and at the total cost of £35 18*s.*, which, added to the drivers' wages and other working expenses as above, (exclusive of repairs,) gave an amount of £64 19*s.* 9*d.*, and with the addition of all repairs during this period, amounting to only £1 7*s.* 1*d.*, gave a total expense of £66 6*s.* 10*d.*, or average of 10½*d.* per mile, being 16 per cent. less than the cost with coal, in actual expenditure, though with an effect of 25 per cent. greater, weight for weight.

It must also be recorded that the water in the tender was *hot*, during the experiment with coal, and *cold*, during that with coke. During this latter experiment, the engine required no further repairs than the ordinary tightening of coffers, and is now in as perfect working order as when the experiment was commenced. The amount of repairs caused by the use of coal cannot fail to appear very great; but it is an accurate statement of the repairs actually incurred in running the 1500 miles with coal, and may be better understood when I state to you, that in the course of the first ten days, several of the steam joints at the smoke-box end of the engine were burnt out, causing some days' delay. These were repaired, but, by the time the experiment was finished, others had failed more extensively, which involved a general repair of all the joints throughout that part of the engine, and caused a further delay of a fortnight, before the engine could be again put to work. But, besides these effects I find there are others of a more important nature, which must tend to the great injury and depreciation of the engine, if not to serious accident, to which they cause a constant liability. The small particles of coal which are driven in a half burned state, through the tubes, are, after the engine has travelled a few miles, collected in a mass in the bottom of the smoke-box, and these, being at length acted upon by the flame from the fire, are brought to such an intense heat that *the cylinders become nearly red hot;* which not only renders it impossible to keep any lubrication to the pistons, but incurs very great risk of the cylinders being cracked by the working of the pistons in this dry state. The plates of the smoke-box are also made red hot, becoming buckled, and out of form; and all the stuffing-boxes require repacking nearly every day.

I felt much disappointed with these results, and was, at first somewhat at a loss to account for the difference in effect on this engine, and on the "BEE." I now attribute it, however, in some measure to the size of the fire-box of the "WOLF," as compared to that of the "BEE," but still more to the running long distances with the "WOLF," and pulling in all cases a nearly maximum load, which had not been done with the "BEE" engine.

It is a source of satisfaction to me to be confirmed in this view by the results communicated to me by Mr. Marshall,—who is

at the head of the locomotive department of the North Midland Railway, as to the working of Mr. Hall's apparatus on two of the engines of that company. They first commenced running short trips with frequent stoppages, and such favourable effects were produced, that Mr. Marshall was induced to place one of the engines on the traffic between Derby and Normanton: but a few days showed the same results as I have stated in the case of the "WOLF." So intense and uncontrollable was the flame that the whole smoke-box end of the engine was a mass of fire, and the heat was intense enough to ignite the sand-boxes, which are carried on the frame of the engine.

The fire was discharged from the chimney in such dense volumes, that the guards and enginemen were in constant fear of the goods being burned. The consumption on the North Midland Railway in these trials was 25 per cent. more of coal than coke.

I have a statement also from Mr. Kirtlay of the Derby and Birmingham line, showing a very great loss to that company in the consumption of fuel alone, insomuch that the burning of coal has been abandoned on that line altogether.

The Manchester and Leeds Company have made a similar trial, but with such unsatisfactory results as to cause them to abandon it also.

With these facts before me, elicited by my own experience, and confirmed by that of others, I most certainly cannot recommend you to proceed further in a project so dangerously uncertain in its results, and which would entail constant expense without any prospect of eventual good; with a certainty of requiring a much larger number of engines to do the same quantity of work.

I have given this subject much careful consideration, in the earnest hope of success, and I have taken every precaution to have the engine used in these experiments, as complete in every respect as possible:—nor is it without having weighed the matter fully and deliberately, that I have arrived at the decided conclusion I have announced to you: but the more I consider the subject, the more assured I am that my decision is sound, and such only as a regard to your interests can justify me in adopting. I conclude by reiterating what I expressed to you twelve months ago, when this subject was first mentioned, viz. that "coal cannot be advantageously used as fuel for locomotive engines, under their present construction," and, "running at the high speeds required on the railways of the present day."

I am, Gentlemen,
Your most obedient servant,
JOSIAH KEARSLEY.

Derby, August 9, 1842.

## MR. BOOTH'S "THEORY AND PRACTICE OF PROPELLING THROUGH WATER."—ANOTHER NOTABLE DISCOVERY.

Sir,—The most remarkable of the many strange doctrines advanced by Mr. Booth in his pamphlet on "*The Theory and Practice of Propelling through Water*," appears to me to be that on the size of the valve plate. He says:—

"I will admit, that in the proposed scheme it will be desirable to have valve plates large enough to meet a *far greater resistance* in the water during the main stroke of the propeller, than the resistance at present offered to the paddle-wheel, during the same extent of motion. But a small valve-plate or paddle board will accomplish this object. I shall suppose, that on the proposed plan the paddle board will be three times as deep in the water as the floats of the ordinary paddle-wheel. By the law of hydrostatics, this condition would give fiv times the power to the *water as a fulcrum* of resistance, which is its proper function i relation to the paddle board; consequently, a paddle board of *three square feet* area would be as efficient at the increased depth as one 15 feet area at the lesser depth."

I ask with you, "Can such things really be?" Can Mr. Booth persuade us that there is a "*law of hydrostatics*" so remarkable, that a body moving through water at a depth of 15 feet below the surface, encounters five times as much resistance as one immersed only 3 feet? If he can, let me earnestly beg of him to lose no time in doing so, and at the same time, informing your readers, where this law, this remarkable law, upon which the efficiency of his plan of propulsion is based, is propounded.

I am, Sir, your obedient servant,
JOHN LAKE.

August 23, 1842.

## LIFE INSURANCE—NEW COMPANY ON OLD BUT FALSE PRINCIPLES.

Sir,—I am rather disposed to think that the question on Life Assurance, proposed by Iver McIver, was not altogether fortuitous; for I have at this minute before me a prospectus of a new Annuity and Life Assurance Company, where it is proposed to assure lives exactly in the same way as stated in his question. It is stated in this prospectus that the Northampton Table of the duration of lives is to form the basis of calculation, and that the rate of interest allowed

to the insured is to be 4 per cent. (!) and that ⅕th of the profits arising from deaths (I. M. states ⅓rd) is to go for the purpose of defraying the expense of management. Can there be any doubt that a mode of assurance founded upon such data must infallibly end in the ruin of the company?

As none of your mathematical contributors have yet given a proof of the theorem given in No. 921, page 269, I take this opportunity of doing so.

Mr. Scott supposes that the number living at the beginning of each successive year form a series in arithmetical progression, or what is the same thing, that the decrements of life are constant, or nearly so.

Therefore, let $s = \frac{b}{R} + \frac{c}{R^2} + \frac{d}{R^3}$ &c., $\frac{x}{R^n}$. Then, by supposition, $b-c = c-d = d-e$ &c. Let this difference be denoted by D; then the above series is evidently equal to the difference of the two series. For,

$$\frac{b}{R} + \frac{b}{R^2} + \frac{b}{R^3} + \text{\&c. } \frac{b}{R^n}; \text{ or,}$$

$$b\left(\frac{1}{R} + \frac{1}{R^2} + \frac{1}{R^3} + \text{\&c. } \frac{1}{R^n}\right), \text{ and}$$

$$\frac{D}{R^2} + \frac{2D}{R^3} + \frac{3D}{R^4} + \text{\&c. } \frac{(n-1)D}{R^n};$$

$$\text{or } D\left(\frac{1}{R^2} + \frac{2}{R^3} + \frac{3}{R^4} + \text{\&c. } \frac{n-1}{R^n}\right);$$

$$\text{now } b\left(\frac{1}{R} + \frac{1}{R^2} + \frac{1}{R^3} + \text{\&c. } \frac{1}{R^n}\right)$$

$$= b\,\frac{(R^n-1)}{R^n(R-1)}. \quad \text{Assume,}$$

$$S^1 = \frac{1}{R^2} + \frac{2}{R^3} + \frac{3}{R^4} + \text{\&c. } \frac{n-1}{R^n}$$

$$\therefore \frac{S^1}{R} = \frac{1}{R^3} + \frac{2}{R^4} + \text{\&c., } \frac{n-b}{R^{n+1}}.$$

Hence, by subtraction,

$$S^1 - \frac{S^1}{R} = \frac{1}{R^2} + \frac{1}{R^3} + \frac{1}{R^4} \text{ \&c., } \frac{n-1}{R^{n+1}}$$

$$\text{or } R\,S^1 - S^1 = \frac{1}{R} + \frac{1}{R^2} + \frac{1}{R^3} \text{ \&c. } \frac{n-1}{R^n}$$

$$= \left(\frac{(R^{n-1}-1)}{R^{n-1}(R-1)}\right) - \frac{n-1}{R^n}$$

$$= \frac{R^n - R}{R^n(R-1)^2} - \frac{n-1}{R^n}$$

$$\therefore S^1 = \frac{R^n - R}{R^n(R-1)^2} - \frac{n-1}{R^n} = \frac{(R^n-R)-(n-1)\,(R-1)}{R^n(R-1)^2}. \text{ Consequently,}$$

$$D\left(\frac{1}{R^2} + \frac{2}{R^3} + \frac{3}{R^4} + \text{\&c. } \frac{n-1}{R^n}\right) = D\,\frac{(R^n-R)-(n-1)\,.\,(R-1)}{R^n(R-1)^2}.$$

$$\text{Hence, } \frac{b}{R} + \frac{c}{R^2} + \frac{d}{R^3} + \text{\&c.} = b\left(\frac{1}{R} + \frac{1}{R^2} + \frac{1}{R^4} + \text{\&c.}\right)$$

$$-D\left(\frac{1}{R^2} + \frac{2}{R^3} + \frac{3}{R^4} + \text{\&c.}\right) = b\,\frac{(R^n-1)}{R^n(R-1)} - D\,\frac{(R^n-R)-(n-1)\,.\,(R-1)}{R^n(R-1)^2}$$

$$= \frac{b\,(R^n-1)\,.\,(R-1) - D\,(R^n-R)-(n-1)-(R-1)}{R^n(R-1)^2}$$

$$= b\,\frac{(R^{n+1}+1)-(R^n+R) - D\,(R^n-R)-(n-1)\,.\,(R-1)}{R^n(R-1)^2}.$$

$$\text{Hence, } P = \frac{1}{a}\left(\frac{1b}{R} + \frac{c}{R^2} + \frac{d}{R^3} + \text{\&c.}\right)$$

$$= b\,\frac{(R^{n+1}+1)-(R^n-R)-D\,(R^n-R)-(n-1)\,.\,(R-1)}{a\,(R^n(R-1)^2}$$

$$= b\,\frac{(R^n-1)\,.\,(R-1)-D\,.\,(R^n-R)-(n-1)\,.\,(R-1)}{a\,R^n(R-1)^2}$$

$$= b\,\frac{(R^n-1)\,r - D(R^n-R)-(n-1)\,r}{a\,R^n\,r^2}$$

where $r = R-1$.

KINCLAVEN.

### BEQUEST OF A PERPETUAL MOTIONIST.

Darlington, August 23, 1842.

Sir,—In May 1841, I sent you an article on Steam Carriages, by my late brother, Thomas Blackett, which you were so good as to insert in the Number for June 26. At that time, I said I would probably send you some more selections from my beloved brother's papers. In looking over them for this purpose, I have met with the following paper, which I would feel obliged to you to insert early as as convenient.

I remain, Sir, with great respect, &c.,

ELIZABETH BLACKETT.

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As it seems to me very probable that I am not destined to try the following method of producing perpetual motion, though the mechanism for trying it is almost ready, requiring only some very trifling alterations, and has been these four or five years—(presumptive proof that I am not destined to try it, and indeed *now* I do not wish it)—I say, such being the case, and having a strong conviction, amounting almost to a moral certainty, that it will answer, and that it is capable of being proved by a rigid demonstration, I had undertaken the study of mathematics, and I had made some progress, in geometry, with a view fully to demonstrate that the mechanism hereafter to be described will accomplish it. But circumstances have since occurred, which have brought my labours in that way to a close; and, as I am not willing that posterity should lose the benefit of such a discovery, I shall at once proceed to describe it, and to prove it, as far as I am able.

As I have given a drawing and full description of the machine in some other papers, if I never try it myself, I have only to request, that whoever may become possessed of these papers will make the thing public, either by trying the thing effectually themselves, or by sending it to three or four periodicals at the same time, so that no one may unjustly claim the invention. Should they attempt to accomplish the object or not, or should they succeed or not, in any case I should like the thing to be published: at the same time, I should not object to their deriving a profit from it, should they accomplish it.

The model one that I have made differs from the drawing, in that the beams S T are fitted up with parallel motions to the pistons, instead of segment heads and stuffing-boxes; the quicksilver acting on the contrary sides of the pistons fitted to the crank ends, so as to prevent the oblique push of the crank-rod from affecting them sideways. All these were omitted, to render the drawings less confused.

Should it prove applicable as a motive power, and become extensively used, the profit derivable from it would be very considerable; and in that case, I should wish the great proportion of it to be applied in establishing public libraries, picture galleries, collections of statues, (which should be open to every one,) and in establishing courses of lectures, to be delivered periodically, on philosophical subjects, &c., &c., in procuring the apparatus of all kinds that would be necessary, and, in short, to be applied in any way that would be most likely to raise the character, to increase the knowledge and happiness, and promote the welfare of the human race.

THOMAS BLACKETT.

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It is my wish to fulfil every request my brother has expressed, and it not being in my power to try the experiment, I have adopted this mode of giving publicity to his sentiments on the subject. Should any person feel inclined to come forward to try it, he may address to me as below.

ELIZABETH BLACKETT,

Henry Blackett's,
Tubwell-row, Darlington.

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### THE MECHANICS' MAGAZINE IN THE DOCK-YARDS.

Sir,—I feel certain you will be glad to be informed of a striking proof, which came recently under my observation, that your truly valuable periodical has in a large measure answered the end that was designed by its first publication, namely, the full and free circulation of mechanical knowledge, upon which depends so much of our individual comfort and national prosperity.

In No. 24, for 7th February, 1824, you will find a communication from me, describing a new method of driving lathes. Since that time I have found a number of turners adopting my proposed plan; and I am certain that, if the Magazine had had at that time a larger circulation, the plan would have been, by this time, in more general use. Of course, the fault was not in the work, but in those for whose use it was published—the practical mechanics. Being at Chatham a few days ago, on passing through the Dock-yard, I had my attention called (by my son, who was with me,) to the method employed there for driving the lathes. I was led to ask the person who was using one of the lathes, who it was who introduced that method? He told me it was himself; but immediately added, with great candour, that he got the idea from the *Mechanics'*

*Magazine*. He then went to his tool-chest, and took from it the Number I have before mentioned, and showed it us. I need not describe to you, Sir, how happy this little circumstance made me—how pleased I was to find that I had been of some small service, in my day, to the great cause of mechanical improvement. Not forgetting by whose means I was enabled to be of this service, I send you this brief notice of the circumstance, in the hope that, identified as it is with the history of the *Mechanics' Magazine*, you will be disposed to give it a hearty welcome to some spare corner, (at the first opportunity,) in its pages.

I am, Sir, yours truly,

C. W. WILLIAMSON,

Turner in Wood, Metal, &c.

31, Grosvenor-row, Pimlico.

P.S.—I should have said, the plan is applied, at Chatham, both to a foot-lathe and to a lathe driven by steam power.

ABSTRACTS OF SPECIFICATIONS OF ENGLISH PATENTS RECENTLY ENROLLED.

WILLIAM BAKER, GROSVENOR-STREET, GROSVENOR-SQUARE, MIDDLESEX, SURGEON, *for certain improvements in the manufacture of boots and shoes*. Rolls' Chapel, July 27, 1842.

The nature of this invention is stated to consist in a mode of constructing the soles of boots and shoes by introducing a layer of horse or other strong curled hair, (felted or matted together, with or without a layer of caoutchouc,) between the inner and outer soles of shoes and boots, by means of which the damp and cold of the under surface of the outer sole leather of a shoe or boot will not so readily pass to the foot of the wearer of such boot or shoe; and in addition thereto, a sole so made will offer a more elastic substance for the tread of the foot.

When the sole of a boot or shoe is to be composed of more than two thicknesses of leather, then the patentee prefers that the layer of felted or matted hair should lie between the two upper pieces of leather of which the sole is composed. In some cases, in addition to the use of a layer of matted or felted hair, he applies a thin sheet of India-rubber, (caoutchouc,) on the under surface of the matted hair, either by applying the solution of India-rubber, (sometimes called India-rubber cement, which is well known and can readily be purchased,) thereto, or by placing a thin sheet of India-rubber on the under surface of the matted or felted hair when it is introduced between the soles, in manufacturing a boot or shoe.

*Claim*.—"I claim as my invention, *first*, applying a piece or sole of matted or felted hair, or other strong curled hair, between the inner and outer sole, in the manufacture of a shoe or boot, as before described; and, *second*, combining the use of India-rubber and matted or felted hair, as before described, between the inner and outer sole of a boot or shoe, as before described, in the manufacture of the same."

Mr. Baker has given his new boots and shoes the name of "Impilia." We have seen letters from Dr. Paris, Dr. Roots, Dr. Hodgkin, and several other eminent medical men, in which they are very warmly recommended, and an advantage is pointed out as attending them which the patentee himself has overlooked, namely, that they do not creak.

DANIEL GREENFIELD, THE ELDER, OF BIRMINGHAM, IN THE COUNTY OF WARWICK, BRASS-FOUNDER, *for an improvement for the manufacture of hollow metal knobs for the handles of door and other locks*.—Rolls' Chapel Office, August 17, 1842.

This improvement in the manufacture of hollow metal knobs, for the handles of door and other locks, is stated to consist in applying an interior lining of hollow iron to give support and firmness to the brass or other metal which constitutes the exterior surface. The process of manufacturing hollow metal knobs, according to the said improvement, is as follows. First, for preparing the hollow iron lining for the ball part of the knob, a circular disc, of suitable size, according to the size of the knob intended to be made, is cut out of sheet or rolled iron of suitable thickness, by the usual mode of cutting out with a fly-press, and suitable tools of the kind, called a cutting-out punch and holster. The circular disc of the plate being well annealed by fire, is then pressed from its flat state to the shape of a shallow concave dish, (like a saucer,) by forcing it into a concave die with a corresponding tool, forced upon the iron plate by power of a fly-press, or of a stamp. The dish or saucer so formed is afterwards rendered more concave, by subjecting it to a similar operation of pressure in another die, with a corresponding tool. By proceeding in this manner, the same piece of metal which was at first a flat circular disc is rendered by degrees more and more concave, until the form of a deep cup is obtained.

The only difference between the mode of performing the preceding series of operations and those followed in the manufacture of hollow knobs of the ordinary kind, made from brass plate without iron, is stated to be, that the former are performed upon iron

plate, and the latter on brass plate; and that, in consequence of iron being less ductile than brass, the iron must go through a greater number of operations.

The iron must, it appears, be annealed by fire from time to time, as it may require, at suitable stages in the course of going through these operations. About two or three times of annealing, during the course, are said to be sufficient. To prepare the brass or other metal, (such, for instance, as German silver,) which is to form the exterior surface of the ball part of the knob, a square piece of thin sheet brass or other metal, of a suitable size, is cut out with shears, and then that square piece is stamped in the same manner as before described respecting the iron, by a like series of operations, performed in the same or similar dies, and with tools corresponding thereto, except that, in consequence of the ductility of brass or German silver, it is not requisite to subject them to so many successive operations as prescribed for iron.

The mode above described of preparing the deep cup of brass or other metal is stated to be the same as is usually practised in the manufacture of hollow knobs of the ordinary kind, which are made from brass plate without iron, except that the plate of brass or other metal may, in manufacturing according to the present patentee's improvement, be thinner, if desired, than could with propriety be used in manufacturing knobs of the ordinary kind, of brass plate without iron.

The corresponding deep cup of brass or other metal being thus formed, the iron cup is put therein, the border edge of the latter being first clipped round with a pair of clipping tools, to remove the superfluous metal, bringing the edges of the two cups nearly to correspond.

Then the two cups together are forced through a circular hole in a steel ring, by a corresponding tool urged by a fly-press, and thereby the sides of the two cups are drawn in, or contracted to a cylindrical form, and the brass caused to adhere very closely to the iron.

The circular border edge of the compound cup of brass lined with iron is then cut round with shears, so as to reduce the iron and the brass to an exact correspondence, and so as to give a true border edge to the compound cup.

The compound cup is then closed in, or so contracted at the border edge, around the mouth, and at the parts of the sides adjacent to that mouth, as to be of suitable size to receive the large part of the neck of the knob. This closing in of the mouth is performed in the usual manner of closing in, as practised in the manufacture of hollow knobs from brass plate without iron, that is, by means of a pair of closing tools in the fly-press, which force the large open mouth of the cup into a concave hollow die, of a suitable concave shape for gathering in the border edge around the mouth, and also part of the sides adjacent to the mouth, to the proper shape. The preparation of the hollow ball part of the knob is now completed, except that, if the border edge around the contracted mouth be not quite true and smooth, it may be made so by means of a revolving conical tool, furnished with cutting-teeth around its conical surface, such tool being of the nature of a countersink of large size. This tool or countersink may be mounted in a lathe, by affixing it at the end of the revolving spindle of the lathe, so that the countersink will be turned round, and by holding the hollow ball in the hand, and applying the contracted mouth to the revolving countersink for an instant, the border edge of the mouth will be cut by the revolving countersink, and may thereby be rendered truly circular and smooth, and bevelled internally to suit the conical form of the cutting part of the countersink.

If the cutting of the border edge of the compound cup with shears has been truly performed (or it may be filed smooth and true after cutting with shears,) then the border edge of the contracted mouth will, of itself, assume a proper level shape during the contraction, and will continue to be sufficiently smooth and true without cutting that border edge by a countersink, which may therefore be used or not according as may be found requisite.

For preparing the neck part of the knob the hollow iron part for lining the neck may be made of cast-iron, cast into the intended shape with a square hole through the centre of it, and a groove around each end of it, for the purpose of fastening the several parts of the knob together.

To prepare brass or other metal for the exterior surface of the enlarged part of the neck of the knob a piece of the same kind of sheet brass or other metal, as has been used for making the cup, is to be cut out in a square shape, and that square piece is to be stamped in a concave die, so as to bring it (by one or more operations of stamping, as may be requisite,) to the proper form. Then the exterior border of that piece of brass, or other metal, is to be clipped true with shears, and a central hole is to be pierced through it, with a pair of cutting-out tools in the fly-press, that hole being of a proper size to fit tight over the neck part, and then the neck piece is to be forced on to the iron casting, by pressure of suitable tools in the fly-press, so as to make it apply closely thereto.

And in order to prepare brass or other metal, for the exterior surface of the small or neck part, a piece of tubing of brass or other metal, of a suitable size to fit on that neck part, is cut off to the requisite length to form a ferule, which is forced on around the iron, the end of the ferule applying against the piece around the central hole.

To form the collar, or shoulder, around the end of the neck, the neck with the neck-piece, and the ferule upon it is to be put into a mould formed of sand in the usual manner practised by brass-founders, so as to leave a cavity in that mould around so much of the end of the iron neck as protrudes beyond the ferule, and melted brass or German silver, or other metal is to be cast around the said protruding end of the iron, and around the groove thereof, so as to form a collar, or shoulder, which, by that means, becomes firmly fastened around the neck.

The two parts for the knob being thus prepared, (viz.) the hollow ball part, and the neck part, those two parts are to be put together by means of a pair of mounting tools, in the same manner as is commonly practised in manufacturing hollow knobs of brass without iron; that is to say, the neck is dropped into a hollow tool, which permits the collar to go down into the hollow of that tool, and the concavity of the said tool above that hollow affords a resting place for the enlarged part of the neck, and then the hollow ball is dropped with its open mouth over the enlarged part of the neck, and the part of the ball around the mouth thereof, will also find a resting place in the concavity of the tool, and in that position of the parts the border edge of the month of the ball will be opposite to the groove around the enlarged part of the neck, and then by pressure of another suitable concave tool upon the concave part of the ball opposite to the mouth, by force of the fly-press, the part surrounding the open mouth, will be gathered in more closely, and that mouth will be further contracted, so as to interlock its border edge very firmly into the groove, whereby the two parts of the knob become united firmly together, which, being the same mode of union, and being performed with similar tools, and in the same manner as commonly practised in manufacturing hollow knobs of brass without iron does not require further explanation.

The knob, made as before described, is then finished by dressing and burnishing the exterior surface in a lathe in the usual manner, and the collar, or shoulder, is turned true.

The tools employed in the process before described are of the ordinary kind, and such as are well known; and no claim of new invention is made in respect of such tools, nor in the mode of using the same.

*Claim.*—"I do hereby declare, that the new invention, whereof the exclusive use is granted to me by the aforesaid letters patent, consists in the improvement hereinbefore described in manufacturing hollow metal knobs for the handles of door and other locks; the essential character of that improvement being that of forming an interior lining of stamped iron-plate to the hollow-ball part of the knob, and (in case it is preferred) an interior of cast-iron to the neck part of the knob, in order, by means of such stamped iron, and such cast-iron (if the latter be used) to give support to the brass, German silver, or other metal, whereof the exterior surface of such knob, is, or may be composed."

Andrew Kurtz, of Liverpool, Manufacturing Chemist, *for certain improvements in the manufacture of artificial fuel.* Rolls' Chapel Office, August 26, 1842.

The improvements which are the subject of this patent consist, *firstly*, in mixing with inferior coals such proportionate quantities of coke, (made from coals,) rosin, or naphthaline, with pitch, (made from gas-tar,) or other bituminous substance, as will equalize or counterbalance the combustible strength or evaporative power of such inferior coal with that of the best coal known or found in England and Wales. The proportionate quantities of superior combustible matters to be added to the inferior coals, in order to bring them up to the same standard of evaporative power as the best English or Welsh coal, must of course depend upon the inferiority of the coal to be improved, and as the British government standard for contracts for artificial fuel is, that one pound of fuel shall evaporate eight pounds of water, the present patentee takes that as his standard, and the following experiments are related, as showing the manner and proportions in which the addition of combustible matters must be made to inferior coal. "I have found," says Mr. Kurtz, "that the evaporative power of coals is as follows, (by way of illustration:) one pound of anthracite coal will evaporate eight pounds of water; one pound of best Welsh coals, 7 lbs. to 8 lbs.; one pound of Liverpool coals, called Smith's coals, 7 lbs.; one pound of ordinary Liverpool coals, 4 lbs. to 6 lbs. Newcastle coals are similar in effect to Liverpool coals, so that it will be readily perceived, that where the best Welsh coal wants, as it were, one of superior combustible matter, ordinary or inferior coals will require four or more parts, and that the proportions must be suited and varied according to the ascertained quality of the coals when in a natural state."

The patentee claims, *secondly*, certain improvements "in the application and use of certain machinery or apparatus, for the purpose of preparing or mixing the component parts of such artificial fuel, and forming or moulding the same into portable and convenient shapes or bricks for use, as follows." The natural coal is first to be ground small between an ordinary pair of horizontal grinding-stones, or in a grinding-mill, and is afterwards to be submitted to a drying kiln or apparatus, for the purpose of expelling all moisture from the coal. This drying apparatus is to be constructed with three chambers or compartments, say 12 feet long by 9 feet wide, and by 6 feet deep altogether. The flooring of these chambers should be of plate-iron, and somewhat dished or sunk in the middle, and also provided with a small aperture or opening, with a sliding door or cover to each. Between each compartment, and around these chambers, there are flues heated by the flame and air proceeding from the furnace or fire-place situate at one end of the apparatus, and each flue is to be provided with a damper, to regulate the heat as required. The upper chamber or compartment is open at top, and may be called the reservoir; and in this the ground coal is to be placed, after being taken from the grinding apparatus, and heated or dried, so that the principal part of the moisture is evaporated; the sliding door is then to be removed from the opening in the bottom of this reservoir, and the coal raked or pushed down into the middle, or drying chamber. In this chamber the pulverized coal is also to be further dried and heated to about 300° Fahr., so that no moisture whatever remains. The sliding door is next to be removed from the aperture in the bottom of this chamber also, and the coal passed into the bottom, or mixing chamber. The pulverized and dried coal now lying in the lower chamber, the pitch, or other auxiliary combustible matter, is to be supplied through a trough, or other convenient means, and in such proportions as have been previously ascertained, and dependant upon the quality of the coal under operation, and after being sufficiently mixed together, by raking or otherwise, may be carried away in boxes or baskets to the next process. The composition or artificial fuel now being in a plastic state, is in the next place to be put into a machine very similar in form, and in the mode of operation, to an ordinary clay or pug-mill, as used by brickmakers. The form of this apparatus is similar to a vat, say of 6 feet diameter at top, and 8 or 9 feet deep, and tapering downwards. This vat or chamber is to be of cast-iron, and surrounded with a jacket or casing, to act as a steam-chamber, in order to keep the composition under operation in a continuous heated state, and thus capable of being more efficiently worked. For this purpose, a steam-pipe is supplied to the lower part of the casing of the pug-mill, conveying the waste steam from the steam-engine employed to work the whole system of apparatus, and which steam is to be passed off at the upper part of the vessel, the condensed water escaping below. The interior of this pug-mill is somewhat peculiar in its construction, and consists of a central upright shaft driven from gearing below, in connexion with a steam-engine or other moving power. Upon this shaft, of about 6 inches in diameter at the lower end, and tapering upwards to about 4 inches, are placed several pairs of arms or agitators, say about 6 pairs, about 9 inches wide, and reaching to within about an inch of the inside of the mill, at the top, and about 6 inches at the bottom, each alternate pair being set or fixed at right angles with the adjoining pair, and each arm placed at an angle of about 20° from the plane of the horizon, so that, as the shaft revolves, these arms or agitators will act as one continuous screw, and keep forcing or conducting the composition in the mill towards the bottom, simultaneously with the mixing and puggling process. A separate or independent arm is also fixed at the lower end of the shaft, and touching the bottom of the pug-mill. This arm is formed heliacally, and its outer end forces the composition or fuel in a continuous stream or course, out of an aperture or mouth-piece formed at the bottom of the mill. This aperture or trough may be shaped in any way, being open at the top, and having the sides and bottom square, so as to shape or form the plastic composition as it is being forced from the mill. Masses of this compound are now to be taken from the opening at the bottom of the pug-mill, and, whilst in a heated state, to be thrown or cast into square boxes or frames, the depth of an ordinary brick, when the plastic material will flatten as it cools, and spread itself evenly until it is confined by the sides of the frame; these frames may be large enough to contain a sufficient quantity to form 100 bricks or cakes of fuel. When the composition is sufficiently cooled, but not allowed to harden, it may be cut into forms or bricks, by means of a cylinder having a series of rotary cutters placed thereon, at given distances apart, and projecting from the cylinder so as to pass through the entire depth of the cake of fuel in the frames. This cylinder, or series of cutters, is to be passed across the composition in the frames lengthwise, and will thus cut up the fuel into lengths; and a similar

series of rotary cutters must be passed over the frames crosswise, and will thus form or cut the fuel into oblong squares or bricks. The frames must be well moistened with a strong solution of milk or lime, and the cutters and cylinders must also be well supplied with a similar solution from a saturated brush above, so that all sides of the bricks or cakes of fuel shall be coated over with lime, which will prevent their adhering to each other when packed closely together for use. The hardness of the fuel may be varied, and its capability of withstanding the effects of different climates, may be modified by a greater or lesser proportion of the pitch, or other emollient materials.

*Claim.*—"I claim as my invention the manufacture of artificial fuel, firstly, by bringing all natural coals to one uniform standard of combustible power or effect by artificial means; that is, by adding such proportions of coke, rosin, and naphthaline, with pitch, to inferior coals, as will equalize or counterbalance the combustible strength of the best coals known or found in England and Wales; and, secondly, the application and employment of the machinery or apparatus herein described for the purpose of preparing, mixing, and pressing or shaping such artificial fuel into convenient portions, shapes, or bricks, for use."

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## INSTITUTION OF CIVIL ENGINEERS.

May 10, 1842.

*"Description of a Flax Mill recently erected by Messrs. Marshall and Co. at Leeds." By James Combe, Assoc. Inst. C.E.*

The mill described in this communication consists of one room, 396 feet long by 216 feet wide, covering nearly two acres of ground. The roof is formed of brick groined arches 21 feet high by 36 feet span, upon cast-iron pillars: an impermeable covering of coal-tar and lime is laid on a coating of rough plaster over the arches, and upon that is a layer of earth 8 inches thick, sown with grass. This immense room is lighted and ventilated by a series of skylights 13 feet 6 inches diameter; one at the centre of each arch. A vaulted cellar with brick pillars extends under the whole of the building, and contains the shafts for communicating the motion from a pair of engines of 100 horses' power, to the machinery in the mill; the flues and steam cases for warming and ventilating; the revolving fan for urging the air into the room, with the gas and water pipes, and the remainder of the space is appropriated for warehouses.

The heating and ventilating are effected by a large fan, which forces the air through the pipes of two steam chests, each 10 feet long, and containing together 364 pipes of 3¼ inches bore: the temperature can be regulated by the quantity of steam which is admitted into the chests, or by allowing a portion of cold air to pass by without traversing the pipes; valves and doors in the flues permit any temperature which is desired to be obtained, or that degree of moisture which is essential for some part of the process of working flax.

The general details of the construction of the building are given, with the dimensions of the brick and stone work; the cast-iron pillars and caps, the wrought-iron tie-bars, with the reasons for adding a second set after the accident occurred to the first set: the mode of drainage from the roof; and the striking the centres of the arches, &c.

The total cost of the mill, including the ornamental stone front, was £27,413, which is stated to be about the same cost as that of a good fire-proof mill on the common plan; but as this mode of construction was novel to the workmen, it is probable that a second building of the kind would be less expensive.

The advantages resulting from the plan are, convenience of supervision, facility of access to the machines, the power of sustaining uniformity of temperature and moisture, the absence of currents of air which are so objectionable in other mills, the simplicity of the driving gear, and the excellent ventilation which is so desirable for the health of the workpeople.

The paper was illustrated by two drawings with a sheet of reference, and an appendix contained the result of some experiments upon the strain on the tie-bolts, the pressure on the arches, and the deflection of the bolts, &c.

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Mr. Smith was much pleased to find this description of building brought before the Institution, as he had been the first to adopt it for a weaving shed of the extent of half an acre; the columns for carrying the arches were 30 feet 6 inches apart, and the skylights were 8 feet in diameter; some of the arches were of brick, with stone springers; others were entirely built with rubble stone well grouted, which latter mode of construction he found succeeded quite as well as brick: the settlement of the arches on striking the centres after standing four days was only ⅜ths of an inch: The arches were thickly plastered with common mortar and at first were only covered with a coating of boiled coal-tar pitch and lime ⅜ths of an inch thick, but as the wet penetrated, the thickness of coal-tar pitch was increased to ⅜ths of an inch, with a mixture of sharp

sand, which had proved perfectly water-tight: for some months there was an appearance of moisture, which proceeded from the interior of the brick-work, as it could not escape outwards on account of the impermeable covering; after some time the copious ventilation carried off this moisture and the building became perfectly dry. Over the coal tar a thickness of earth is laid, which is cultivated, and has proved a prolific garden: in severe weather the frost has not reached above $1\frac{1}{2}$ inch deep in the soil, while it has penetrated to the extent of 12 inches in other situations.

The construction of the floor is peculiar: it is desirable in such weaving sheds to have a boarded floor, to prevent the small parts of the machinery from being broken by falls, and also on account of the health of the persons employed; but the vibration of an ordinary wood floor is objectionable. In order to meet these views, a bed of concrete was laid throughout the building, a series of small deal spars $1\frac{1}{2}$ inch deep by 1 inch wide were set flush into the concrete whilst it was wet, and the whole surface was smooth plastered: upon this bed, when it was perfectly dry, a floor of boards $1\frac{1}{4}$th inch thick was nailed to the spars: it was found to combine the solidity of pavement with all the advantages of a wood floor, and there had not been any symptoms of dry rot; which might be attributed to their being no cavities left beneath the boards, the whole being firmly bedded down.

The ventilation was effected by tunnels beneath the floor, the covers of which wer pierced with a number of small holes to spread the air. The warming was accomplished by means of hot water circulating under the pressure of the atmosphere only, in "tubes of tin plate" 4 inches diameter; the temperature was very regular and perfectly under control. With one ton of coal per week the shed could be kept up to 70° during the winter.

The cost of this building was 30 shillings per square yard of area covered, which was less than the cost of Messrs. Marshall's mill, but building materials were much cheaper at Deanston than at Leeds. He expected that this mode of building would become more general as it combined many advantages, and whatever might be the first outlay in purchasing ground, the cost of which was the only inducement for constructing buildings of several stories in height, it would be fully compensated by the facility of superintendence alone, as in manufactories this was of the utmost importance.

These buildings would, he believed, be eventually used for agricultural purposes, and when engineering knowledge was more directed to the processes of agriculture, good results might be anticipated: his attention had been particularly directed to the subject, and he was convinced of the necessity of concentrated superintendence which is not at present possible in the separate farm-steadings as they are now constructed: this might be apparently foreign to the subject before the meeting, but the range of engineering was so wide that it was difficult to say where it should stop.

Mr. Lindsay Carnegie as a landed proprietor could bear testimony to the importance of the connexion of engineering with agriculture, and to the advantages already derived from the improvements which had been introduced by Mr. Smith, who might be justly termed the father of the improved system of agriculture in Scotland.

Mr. Marshall explained that he was indebted to Mr. Smith for the suggestion of this mode of construction, which he had not hesitated to adopt, although all the plans had been prepared for mills of several stories in height—he had been convinced of the superiority of the present plan and his expectations had been fully realized. There were, of course, some difficulties to be overcome and some experiments to try, all of which had not been successful, but in all the essential points this kind of building was superior to any other. An equality of temperature and a facility of imparting a certain degree of moisture to the air which was indispensable for spinning yarn had been perfectly attained.

A member inquired whether the arches were found to be perfectly water-tight? On some of the railways which were laid upon arches it had been found that asphalte had failed in rendering them impervious, and they were consequently useless, even for store-houses.

Mr. Marshall explained that a few leaks had occurred, particularly near the skylight-frames, but they had been easily repaired and were now water-tight.

Mr. Combe found that a mixture of finely-sifted engine ashes with the coal-tar pitch was better than lime. The depth of soil above the arches should be sufficient to prevent the heat of the sun from penetrating through the cracks to the pitch and forcing it up. He had recently examined the roof carefully and could only discover six indications of moisture penetrating; these had been easily repaired and all was now perfectly sound.

Mr. Field agreed with Mr. Smith in his estimation of the advantages of carrying on all manufacturing processes as much as possible under one roof and on one floor—great economy of time and labour would result, espe-

cially where heavy masses, such as parts of machinery required to be moved about—he would always adopt the system in constructing a manufactory.

Mr. Smith observed that an arched roof would be found as cheap as one of wood and slates, and in the relative durability there could be no comparison.

Mr. Marshall desired it to be borne in mind, that the cut stone front of the mill had greatly enhanced the cost, and that being the first building of the kind erected in the neighbourhood of Leeds it had naturally been more expensive than others would be.

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"*Account of the Explosion of a Steam Boiler at the Penydarran Iron Works, South Wales.*" *By Adrian Stephens.*

The boiler, the explosion of which is described in the paper, was one of a pair for furnishing steam to a high-pressure engine, with a cylinder of 26 inches diameter, working expansively, the steam being cut off at half the stroke; each of these boilers was 41 feet long, and 7 feet diameter, with a centre tube flue of 4 feet 2 inches diameter; the thickness of the plates throughout was $\frac{1}{2}$ inch; the ends were flat, with rings of angle-iron, and the pressure of the steam to which the safety valves were weighted was 50 lbs. on the square inch.

From appearances after the explosion, it was conjectured that the tube, which was collapsed in a remarkable manner in its entire length, had been softened by the heat, having probably been left dry along the upper side.

No opinion is given as to the cause of the explosion, but it is particularly mentioned that the supply of feed-water depended upon the regular attention of the engineer, and that the feed-pipe was placed so that the water fell directly upon the hottest part of the tube flue, and it is remarkable that the tube is most extensively fractured at that spot.

All the appearances presented by the boiler, both before and after the explosion, and the injury done by the event, are accurately detailed, and the paper was illustrated by a drawing of the boiler and the setting.

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Mr. Carnegie presented one of Hunter's Stone Boring Machines to the Institution, and explained its action to the meeting.

The machine is composed of two parallel bars of steel, supporting a traversing carriage, through the centre of which passes a spiral auger attached to a screwed bar; this bar fits into a female screw clamp above the carriage, and on the upper end is a winch with four handles.

When the instrument is in use, it is fixed by two cramps upon the stone to be pierced, and the auger being made to revolve by means of the winch, scoops out at each revolution as great a depth of stone as is equal to the distance which the screw descends; the chips ascending through the spiral channel of the auger are thrown off at the top. The peculiar shape of the point of the auger prevents its being abraded, as it operates by chipping the stone, and not by grinding it away. This, with the means of forcing it down by the screw, is the chief novelty of the machine. It has been extensively used at the works of the new harbour of Arbroath, by Mr. Leslie, who speaks of it in the following terms:—

"Mr. Hunter's Boring Machine has been advantageously employed for above a year, in boring trenail holes in the stones used at the new harbour of Arbroath. The holes are $1\frac{3}{4}$ inch diameter, and from nine inches to 2 feet in depth: the aggregate of the holes already bored amounts to upwards of 30,000 linear feet. The machine may be adapted for boring holes of any dimensions. It does the work considerably cheaper than the "jumper," and much more correctly, as it makes the holes perfectly straight, cylindrical, and equal throughout, instead of the irregular form made by the common jumper. This machine is very well adapted for boring railway blocks, and has been much used in this quarter for that purpose. I consider it to be more especially valuable from the facility which it affords of boring and trenailing down the stones used in sea buildings, in any exposed situation; as I have found that trenailing is a great security to such building while in progress, when the upper courses are much exposed, and liable to be washed off, unless they be held down by other means than their own absolute weight.

"The expense of boring the old red sandstone rock, here, is about three-halfpence per linear foot."

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Mr. Vignoles bore testimony to the advantages of the machine: he was now employing it for piercing holes in stones going from Arbroath to the West Indies, for the construction of a patent slip—there was great economy of cost and time by its use, in addition to the superior manner in which the holes were made.

Mr. Smith was convinced of the advantage of the machine in working almost all kinds of stone, but more especially for those resembling the Arbroath stones, which were from a bed beneath the old red sandstone: they were of fine grit mingled with schistose debris. The action of the tool was like that of the stone-planing machine, to burst chips

off instead of grinding down the surface by small portions and destroying the edge of the tool at the same time. With the planing machine it was common to take off a thickness of 3 inches at one passage of the tool—it acted like a "pick;" and being fixed in a frame weighing about 1½ ton, the power was great; at the same time there was little abrasion of the tool and it never became heated or softened. It was probable that with other qualities of stone a screw with another pitch of thread might be required to force the auger forward, but with the thread now used in boring stones from the Arbroath quarries, the economy of time and cost appeared very great. In each of the blocks for the Arbroath railway it was requisite to bore two trenail holes 1¼ inch diameter and 6 inches deep—and to level a space 9 inches diameter to receive the cast-iron chair: this had been contracted for at twopence halfpenny per block, which was a material diminution of the usual cost. He was convinced that the instrument only required to be known to be extensively used.

May 21, 1842.

"*On the Machinery used for working the Diving Bell at Kingstown Harbour, Dublin.*" *By Peter Henderson, Assoc. Inst. C.E.*

After referring for the details of the machinery to the two drawings which accompany the paper, the author describes the foundations of the pier head to have been laid in a depth of 20 feet at low water on rock and firm sand. For 14 feet from the bottom, the wall is formed of Runcorn sandstone of fine quality, each stone containing about 50 cubic feet and thoroughly squared. This has been preferred to granite on account of its cheapness and the facility with which it is worked under water.

After the foundation course is secured, from 300 to 350 cubic feet of this walling are frequently set in a perfect manner by the diving-bell during a fair working day of eight hours. The first stone was set on the 5th of August, and by the 1st of January 16,000 cubic feet had been laid.

From 6 feet below low water to the coping, it is proposed to make use of granite in blocks of 50 cubic feet each, which is procured cheaply and in abundance in the immediate neighbourhood.

The piers are finished in the interior by walling of rubble stone carefully laid.

For the purpose of forming this excellent harbour an area of 251 acres has been inclosed between two substantial stone piers of 8,340 feet in length, affording clear anchorage in a depth of water from 15 to 27 feet at low spring tides. The interior shows no natural tendency to collect deposits likely to reduce the depth of water, nor do any of the works exhibit symptoms of deterioration, while its continual occupation by vessels of every description, together with the comparative freedom from accident in Dublin Bay, afford convincing proof of its great utility.

"*Description of a Steam Dredging Engine used upon the Caledonian Canal.*" *By Walter Elliot.*

The machine described in this communication was constructed in the year 1814, expressly for the formation of the Caledonian Canal, and it was also used for deepening the channels through the shoals in Loch Dochfour and Loch Ness. The length of the vessel is 80 feet, by 23 feet in width; the bucket frame is 42 feet long, with 25 buckets, worked by a condensing steam-engine of six horses' power. The dimensions of all the principal parts of the machinery are given minutely, with accounts of several experiments for extending the use of the dredger.

On one occasion, as it was found that the buckets had much difficulty in penetrating the hard mountain clay, every alternate bucket was removed, and a pair of steel cutters substituted for each, in the expectation that the clay would be loosened, and the succeeding bucket would take it up more easily. They did not, however, act satisfactorily, and a risk of fracture was incurred, which induced the abandonment of the plan.

On another occasion in forming a portion of the canal between Loch Ness and the locks at Fort Augustus, where the height of the ground above the water averaged from 20 to 30 feet, and the excavation was required to be about 16 feet beneath it; that part of the cutting above the water level was commenced by manual labour, while the dredging machine did the excavation under water: it was soon found however that the engine having completed its share of the task, continued to undermine the upper portion, which being of a loose nature fell into the water, and was raised by the buckets so rapidly that the manual labour could not compete with the machine, and it was then used to complete the undertaking, which it did in eight months, having in that time excavated about 170,000 cubic yards of material.

When working in favourable situations the quantity generally raised equals 90 tons per hour; 17 of the buckets are discharged per minute, with an expenditure of coal of about 15 cwt. per day.

The communication was illustrated by two detailed drawings of the boat and its machinery.

NOTES AND NOTICES.

*Concussion Shells.*—In the course of some experiments which took place in the Marshes, at Woolwich, on the 26th instant, twelve of Captain Norton's Concussion Shells were fired from a ten-inch gun, at a wooden frame, at a range of twelve hundred and fifty yards. Four of the shells struck the frames, and instantly exploded by the concussion. Eight shells struck the mound, and five out of the eight exploded by the concussion, the instant of striking; three shells that struck the mound did not explode. Each shell had a bursting charge of five pounds of gunpowder; the charge of the gun was twelve pounds. This successful experiment of Captain Norton's Concussion Shell establishes his principle, and fixes the perfect efficiency of his shell.—*United Service Gazette.*

*Precipitation of Metals.*—On the 6th instant, M. Arago read before the Academy of Sciences an analysis of a paper by M. Ruolz, on the means of fixing one metal upon another. In some former experiments communicated to the Society, M. Ruolz had gone no further than the precipitation of pure metals; it remained to be ascertained whether mixed metals might not also be precipitated. This is what M. de Ruolz has done; and, as a proof, several specimens, covered with a precipitate of copper and tin, in the proportions which constitute bronze, were submitted to the Academy.—*Athenæum.* [If this statement be correct, then M. Ruolz has indeed accomplished a great desideratum—the precipitation of *alloys of metals.* But we have reason to believe the statement is *not* correct: all that M. Ruolz does is, to precipitate the copper on the tin, or the tin on the copper, (separately,) which is not new, and a very different thing from precipitating the metals in atomic combination.—*Ed. M. M.*]

*Average working expenses of a railway per mile per train.* — Locomotive power — viz., wages, 2d.; fuel, 4d.; oil, hemp, &c., 1d.; ordinary repairs, 7d.; water and fuel stations, ½d.; reserve fund, 1½d.

| | s. | d. |
|---|---|---|
| Locomotive power (as above) | 1 | 4 |
| Carriages | 0 | 4 |
| Maintenance of line | 0 | 8 |
| Police | 0 | 2 |
| Conducting traffic and stations | 0 | 5 |
| Local rates and taxes | 0 | 3 |
| Government duty on passengers | 0 | 5 |
| Miscellaneous expenses | 0 | 2 |
| Management | 0 | 3 |
| Total | 4 | 0 |

—*Prof. Vignoles' Lectures on Civil Engineering.*

*A Dark Day.*—An interesting account is given of a day of this sort, in North America, in a paper read at a late meeting of the Meteorological Society, by Major Stack. The darkness on the day referred to did not partake of the nature of cloud or smoke, but closeness in the air, which appeared to thicken, and to descend from above, till the bright noonday brilliancy was converted into darkness that might be felt. It came on between 11 and 12 a.m.; extreme darkness, half-past 1: at 5 p.m. it was sufficiently clear for persons to return to their occupations, as all labour was necessarily suspended, and the phenomenon soon disappeared.

*Diving-bells for Men-of-war.*—Commander Henry Downes, R.N., the hon. director of the United Service Institution, has suggested a plan which, in cases of need, he thinks may be found of use. He recommends that in line-of-battle ships, and in the larger frigates, one of the tanks of water should be so constructed as to do, if required, the double duty of tank and diving-bell; and be stowed at the mouth of the hatchway, so as to be the first one to be emptied. One instance may be adduced, wherein a trial has already been made with a ship's tank, and most successfully too, under the skilful and persevering exertions of Captain Dickinson, R.N., in recovering the treasure wrecked in the *Thetis* frigate.

*Prizes for Scientific Essays.*—Count Pillet Will, a corresponding member of the Royal Academy of Sciences at Turin, has sent a donation to the Academy of 10,000 fr., to be distributed in prizes to authors of works best calculated to promote a taste for the positive sciences. The Academy have divided the sum into four prizes of 2,500 fr. each, for the best introductions to the study of physics, chemistry, mechanics, and astronomy. Each work is to contain a concise summary of the principles, history, important facts, and chief application of the science treated upon, so as to be used as an elementary book in the colleges. The competition is open to men of all nations. The manuscripts must be sent to the secretary of the Academy (post free) before the 1st of July, 1846. The successful works will be printed at the expense of Count Pillet Will.

*Metal Forging and Cutting Machine.*—Although at the late meeting of the British Association in Manchester, there were many very interesting specimens of mechanism exhibited, there was, nevertheless, one in particular, which threw all others completely into the shade, when considered either as to the novelty of the invention, or its evident practical applicability to the every day concerns of life—and may with truth be said to have been "the lion of the exhibition,"—viz., a machine for the working or forging of iron, steel, &c. This truly surprising machine is quite portable, occupying only a space of 3 feet by 4 feet, and cannot be deemed other, even by the most critical judges, than one as purely original in principle, as well as practical in its application, as much so perhaps as was the splendid invention of the fluted roller of Arkwright, by which the art and perfection of drawing the fibrous substances became known, or that still more splendid discovery of Watt, the condensing of steam in a separate vessel, by which the power of the steam-engine of that day may be said to have been doubled. But now for some explanation of the machine, and its probable general application. It is, then, as has before been said, very portable, not requiring more space than from three to four feet, and may be worked by steam or water power, and when moved by the former, as was the case at the exhibition, made 650 blows or impressions per minute; but from their very quick succession, and the work being effected by an excentric pressing down, not striking the hammer or swage, not the least noise was heard. There are five or six sets of what may be called anvils and swages in the machine, each varying in size. The speed and correctness with which the machine completes its work, is perfectly astonishing, and must be seen in order that its capabilities in this respect may be duly appreciated; for instance, when it was put into motion for the purpose of producing what is known as a roller, with a coupling square upon it, (and which had to be afterwards turned and fluted,) the thing was accomplished in fifty seconds! of course at one heat, to the astonishment of the bystanders. But what appeared as the most extraordinary part of the affair, was, that the coupling square was produced direct from the machine, so mathematically correct, that no labour can make it more so! The machine will perform the labour of three men and their assistants or strikers, and not only so, but complete its work in a vastly superior manner to that executed by manual labour. For engineers, machine makers, smiths in general, file makers, bolt and screw makers, or for any description of work parallel or taper, it is most specially adapted; and for what is technically known as reducing, it cannot possibly have a successful competitor—in proof of which it may be stated, that a piece of round iron 1⅜ inch in diameter, was reduced to a square of ⅜ in., 2 ft. 5 in. long, at one heat. The merit of this invention belongs, it is said, to a gentleman at Bolton, of the name of Ryder.—*Leeds Mercury.*



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# Mechanics' Magazine,

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No. 996.] SATURDAY, SEPTEMBER 10, 1842. [Price 6*d*.

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## THE "GREAT BRITAIN" STEAM-SHIP, (LATE "MAMMOTH.")

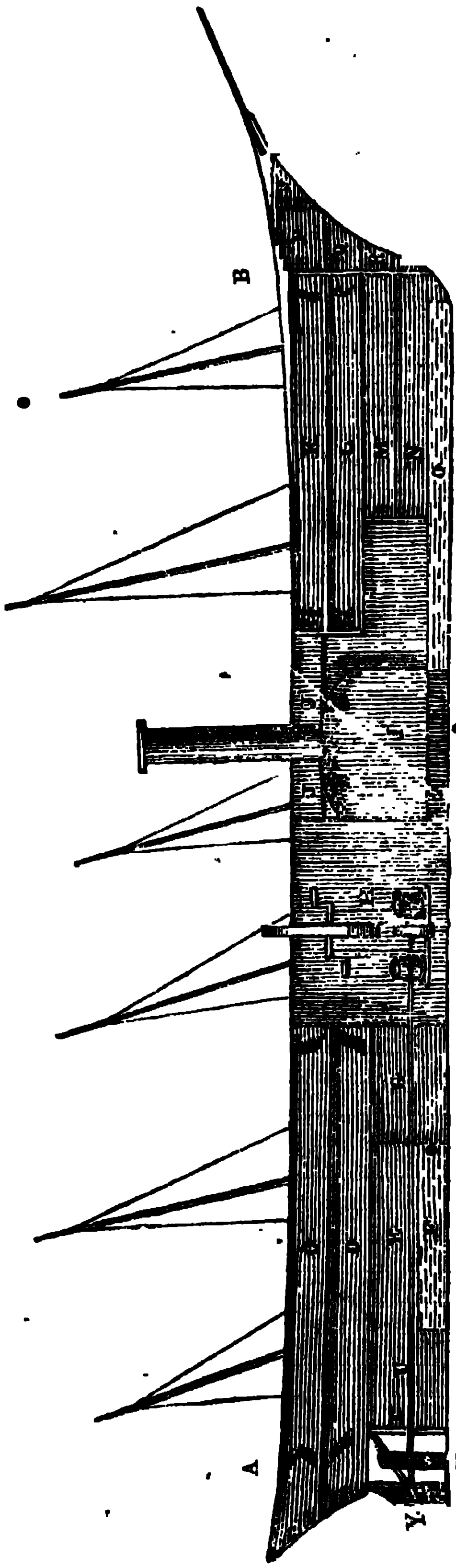



Fig. 1*.

3500 Tons.

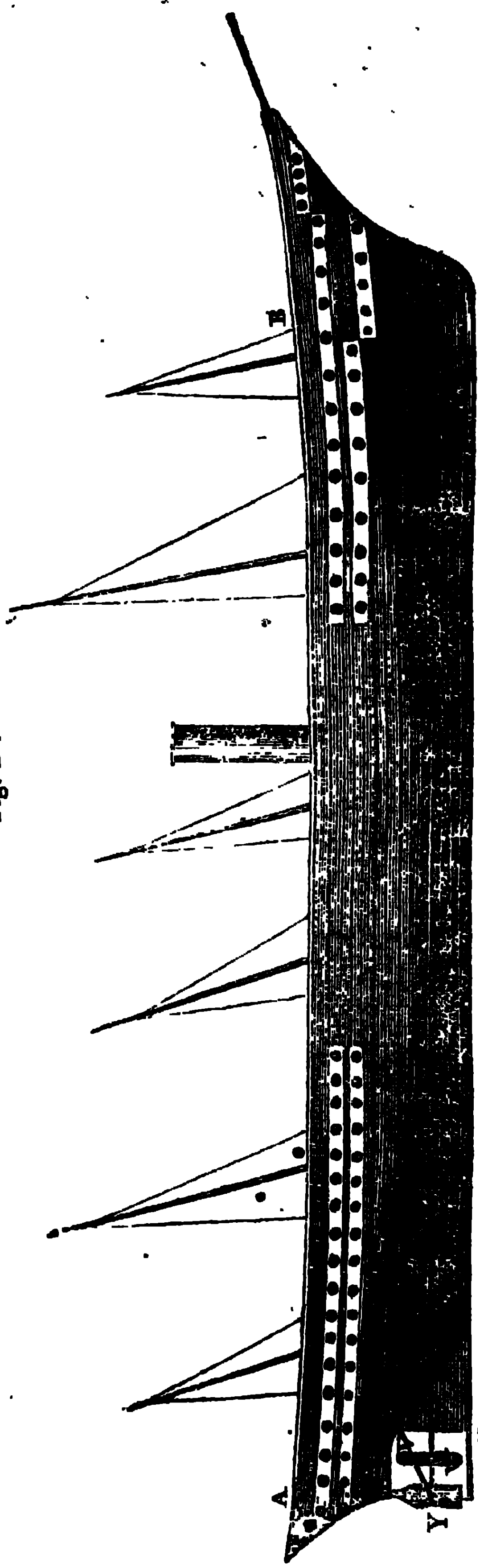



Fig. 2*.

ICCO Horse power.

## DESCRIPTION OF THE "GREAT BRITAIN" STEAM-SHIP, (LATE "MAMMOTH.") BY J. R. HILL, ESQ., C. E.

Sir,—Having taken a more than ordinary interest in the above structure, almost from its commencement, on account of the novelties to be developed, and availed myself of opportunities of examining the progress from time to time—first, through having a slight acquaintance with the late Mr. Humphreys, the engineer, and, secondly, through the kindness and polite deportment of Mr. Guppy, the present resident manager—I feel myself in a position to fulfil my promise to you, of furnishing such general information of the construction of the vessel and engines, as I think will be highly interesting to many of your numerous readers. And I trust I may so far succeed in my description, as to convey a tolerably correct idea of the magnificent vessel, and of the peculiar machinery in preparation.

It is highly probable that some of my dimensions may not be truly correct, (though I believe, in the mass, they will be found not very far from the truth;) but as my notes and rough dimensions were obtained—some of them by pacing, others by a graduated walking-stick—the outline by an optical unerring instrument—some by their apparent magnitude, and comparison with known dimensions—and a few from the information of the Company's servants, deputed to show and explain to the public during the late interesting Agricultural Meeting at Bristol, and, as the collection of these materials has spread over a long period, I trust, should a few errors or inaccuracies be found to exist, they will be quite unimportant.

From my notes and dimensions I have also prepared a few sketches, which, should you consider them of sufficient value for insertion, will the more readily convey an idea of the construction.

### *Description of the entire Ship.*

To prevent any confusion arising from the necessity of using the same letters of reference in describing the vessel as in the machinery, I will first dismiss one alphabet, by spreading it over the ship, and then repeat the same over the details of machinery.

Fig. 1* represents a longitudinal vertical section of the entire vessel, showing the various compartments; and fig. 2* a side view, in the state it was a month ago.

A B. Surface line of upper deck.

C. Principal promenade saloon; length 110 feet, by 48 feet at the widest part; height, 7 feet; to be fitted up with twenty-four single berths on each side: two staircases at each end.

D D. First class saloon, or dining-room: length, 100 feet; greatest width, 50 feet, (which is about equal to the widest part of the "Victory," celebrated in former days;) height, 8 feet: stairs at each end.

E. The cargo deck, 65 feet long, by 9 feet high, running narrow towards the stern.

F is an iron fresh water tank, 18 feet wide towards midships, 7 towards stern, (taking the form of the vessel;) length, 40 feet; height, 6 feet.

G. A room of 24 feet long, 15 feet high, by the width of the vessel: probably a coal-store, and for engineers.

H. Elevation of engines.

I. Ditto of boiler.

J J. Iron deck over boiler, for cooking apparatus.

K. Fore, or second class saloon, 84 feet long, 7 feet 9 inches high.

L. Lower fore saloon, length and height as above; 40 bed-places on each side of these saloons.

M and N. Iron-floored cargo decks.

O. Air-chamber from boiler to fore bulk-head, of the shape of the ship, about 4 feet high.

P. Officers' berths, &c.

Q. Sailors' mess-room.

R. Sailors' berths; *r*, small water-tank.

S. Water-closets.

T. Ship's stern-post, through which the screw passes, and to which the side-plates are riveted.

U. Shaft from engines to screw.

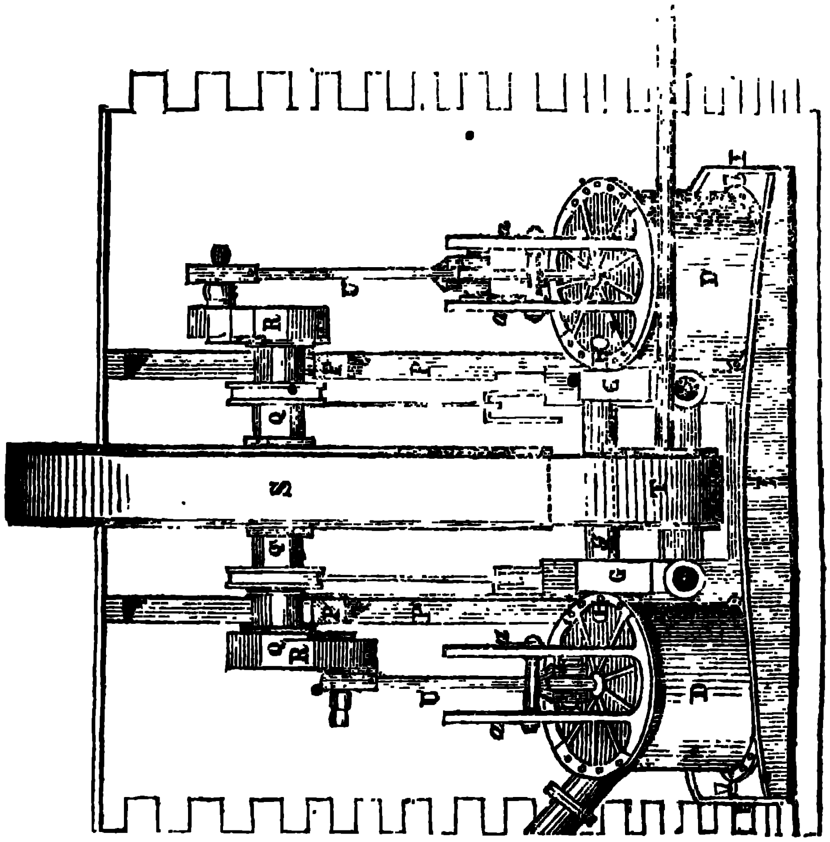
V. Diagonal stay from the ship's side to the stern-post.

W. Side view of screw stern-post, in which the end of the screw spindle revolves.

X. Keel under the screw, uniting the stern-post to the vessel.

Y. Hollow rudder foot, and of such a thickness as to receive the stern-post, which forms its pivot.

*Details of Boiler and Machinery.* Fig. 1 represents a transverse section of the vessel at the engine-room, with an end view of the machinery and boiler.



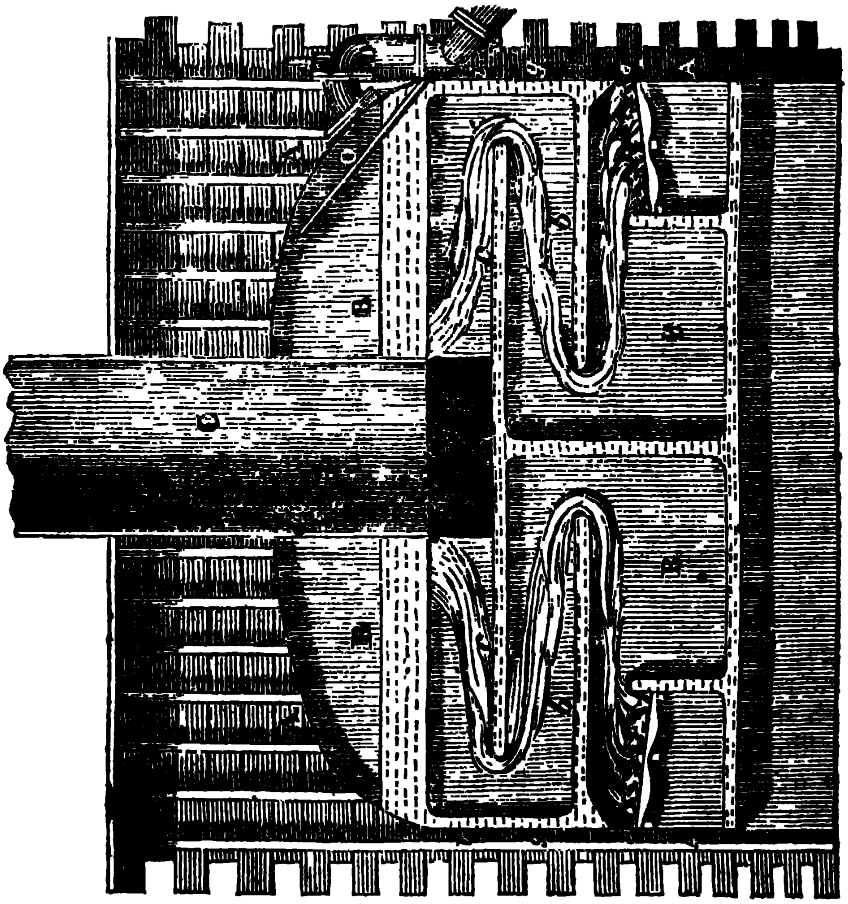


Fig. 2. A longitudinal section of the vessel, with a vertical section of the boiler, and an elevation of the starboard engines.

Fig. 3. Horizontal sections of the boiler, and a general plan of the engines.

Figs. 4 and 5. Outline and section of a cylinder, steam-valves, and a foundation-plate.

Fig. 6. Piston valves, to work in the valve-cases.

Figs. 7 and 8. Side and edge views of the propelling vanes or screw.

And 9 and 10. Development of the screw.

The same letters and figures of reference are used to identify the same parts whenever they occur throughout the drawings.

*The Boiler.*

A A A A represents the outline of the boiler in figs. 1, 2, and 3, which is about 11 yards square in the plan. B B B B is a vertical section through the fires, near the middle of the width, showing the direction of the heated air and flame. *a a*, the furnaces; *b b*, the middle flues; and *c c*, the upper flues. On the boiler plan, in fig. 3, the portion marked *d d* shows a horizontal section through the line *e e*, (see fig. 2;) the portion marked *f f*, a section through at *g g*; and the part marked *h h*, a section through the line at *i i*.

Within the boiler, and opposite the holes for the escape of steam to the engines at O, there is an inclined plate fixed, to prevent "priming," the *top edge* of which the steam has to pass. The entire boiler is divided by two vertical partitions, *j j* and *k k*, thereby forming three distinct sections, either of which may be put out of use if necessary. To each section there is a sluice, or slide-valve, fixed in the casting at D, with its face towards the boiler, the edges of which are planed to form wedges with the points upwards, so that by its being drawn up by the rod, it is at the same time forced hard between the seat frame and inclined brass bars, therefore shutting off the steam from that section of the boiler. C C C, figs. 1, 2, and 3, are an outline, section, and plan of the chimney.

Through the head of the boiler, above the upper flues, there are two wrought-iron tubes of about 15 inches diameter, forming two holes through the boilers "'thwart ships." In each of these holes there is a second wrought-iron pipe, of about 12 inches diameter, the object of which is to form a tie to keep the ship's sides from spreading, and also to act as a strut against external resistance.

The vertical parts of the flues and water spaces are kept in their position by stay-bolts, some of 1¼ inch diameter, and others of 1½ inch diameter, from 15 to 20 inches apart, and supported by props, with shoes and caps riveted to the flues.

The boiler is to be furnished with six water gauges, safety-valves, blow offs, water-valves, and all the usual appurtenances.

*The Engines.*

D D D D are the steam cylinders, which are four in number. E, fig. 4, piston; and F, piston-rod. G G are sections of the steam-valve cases and side-pipes, in which *m* (fig. 5) is the steam branch from the boiler, containing the throttle-valve; *n* is the expansion slide-valve, working against a fixed plain flat face, but perforated with holes, as seen at *p* in fig. 4. *q q q q* are brass linings; *r r r* is the eduction passage from cylinder to condenser. H is an escape-valve in the cylinder cover; as also at I, for the bottom. J J is the foundation-plate; K, condensers; M, air-pumps; N, hot well; P P, boiler and bilge pumps; *s s*, steam pipes to the engines; *t*, beam for parallel motion; *u u*, guide standards for piston-rod; *v*, connecting-rods to the crank; *w*, air-pump connecting-rod; P P P P, wood framing for support of upper works; Q, main shaft; R R, cranks; S, main driving-wheel; T, lower pulley; U, shaft leading to screw.

The dimensions of the principal parts are as follow:—

| | ft. | in. |
|---|---|---|
| Boiler, (square on plan,) about.... | 33 | 0 |
| 24 fires (12 fore and 12 aft) | | |
| Length of fires ................ | 6 | 0 |
| Width of ditto ................ | 2 | 0 |
| Total surface of fire-bar (feet superficial) .................... | 288 | 0 |
| Chimney (diameter) ........... | 8 | 0 |
| Height of ditto, about .......... | 45 | 0 |
| Diameter of 4 cylinders ........ | 7 | 4 |
| Stroke of piston................ | 6 | 0 |
| Diameter of piston-rods ........ | 0 | 9 |
| Steam piston valves, diameter .... | 1 | 8 |
| Stroke of ditto ................ | 1 | 2 |
| Diameter of two air-pumps ...... | 3 | 9 |
| Stroke same as in cylinders ...... | 6 | 0 |
| Two condensers, (wrought-iron, ¾ of an inch thick,) length ...... | 12 | 0 |
| Width........................ | 8 | 6 |
| Average height ............... | 5 | 0 |

| | ft. | in. |
|---|---|---|
| Containing 510 cubic feet, or rather more than the capacity of a double stroke of one cylinder. | | |
| Steam pipes, diameter .......... | 1 | 6 |
| Two foundation-plates for cylinders, length .................... | 27 | 0 |
| Width (parallel) ................ | 8 | 3 |
| Height of outside ribs, at the middle | 1 | 10 |
| Weight of each, from 16 to 17 tons | | |
| Length of main *wrought-iron* shaft | 15 | 9 |
| Diameter at centre for driving-wheel | 2 | 3 |
| Diameter for eccentric bearings and cranks .................... | 2 | 1 |
| And is intended to be bored through its length | | |
| In diameter .................. | 1 | 0 |
| Weight in the rough, as from the forge, upwards of 16 tons. | | |
| Diagonal framing for support of shaft, of very hard and strong foreign wood, of from 10 to 11 inches on the side, proposed to be cased with $\frac{3}{4}$-inch wrought-iron plates. | | |
| Cranks, thickness at large hole.... | 1 | 6 |
| Width at the head .............. | 3 | 6 |
| Diameter of large driving-wheel, said to be intended .............. | 26 | 0 |
| Ditto of rigger on screw shaft .... | 5 | 0 |
| Width of both ................ | 5 | 0 |
| Keel under screw, 12 inches wide on the top face, 9 inches under face, 5 inches thick. | | |
| Screw stern-post, 20 inches across the centre; hole, 10 inches diameter; ends above and below, $2\frac{1}{2}$ inches thick; width, 14 inches parallel; rudder, 6 feet 6 inches wide at bottom. | | |
| Distance between the stern-posts .. | 11 | 0 |
| Height for screw, about ........ | 15 | 0 |

*Farther dimensions and particulars.*

| | | |
|---|---|---|
| "Length of keel .............. | 289 | 0 |
| Ditto from figure-head to taffrail | 320 | 0 |
| Beam ........................ | 51 | 0 |
| Total depth from under side of the upper deck to the keel ........ | 31 | 4 |
| Draught of water when loaded .. | 16 | 0 |
| Tonnage per old measurement, about 3,500 tons.. | | |
| Displacement of water when drawing 16 feet, about 3,000 tons." | | |

The plates of the keel are from $\frac{3}{4}$ inch thick in the middle, to 1 inch at the ends; and all the plates under water are from $\frac{5}{8}$ths to $\frac{1}{2}$ inch at the top, except the upper plate, which is $\frac{5}{8}$ths. She is clencher-built, and double riveted throughout. Towards the extremities, and quite aloft, the thicknesses are reduced gradually to $\frac{7}{16}$ths.

The ribs are framed of angle iron, 6 inches by $3\frac{1}{2}$, by $\frac{1}{2}$ inch thick at the bottom of the vessel, and $\frac{7}{16}$ths thick at the top. The mean distance of the ribs from centre to centre is 14 inches, and all these ribs will be doubled; the distance is then increased to 18 inches, and then gradually to 21 inches at the extremities.

The boiler platform is of plate-iron, supported upon ten iron kelsons, of which the centre ones are 3 feet 3 inches deep. These kelsons are formed like the floorings, of iron plates placed on edge.

The hull is divided into five distinct compartments, by means of substantial water-tight iron bulkheads.

The decks, which are of wood, consist of the cargo deck, two cabin decks, and the upper deck."

The "farther dimensions and particulars," last given, are extracted from the able and valuable treatise on Iron Ship Building, by Mr. Grantham, of Liverpool, and were supplied to him by Mr. Guppy, and therefore may be presumed to be correct, though I am unable to reconcile some parts with my own observation. From the *keel* being mentioned as above, it would probably be inferred by most readers, that it has *an external projecting keel*, similar to a timber-built ship, but such is not the case. The only external projection along the midships is the edges of the central plate, which lies horizontally, and to each edge of which the first rows of plates, forming the hull, are riveted. The ends of the central keel-plates are formed into long scarf joints and well riveted, and the first two or three longitudinal rows of plates have their laps, or external projecting edges pointing upwards, or clencher-build inverted, and above this the edges are downwards, in the ordinary manner, both of which methods appear to be based on scientific reasons.

"The mean distance of the ribs," I think will be found to be from 18 to 20 inches from centre to centre, instead of "14," that is, about the midships, with gradually increasing spaces towards stem and stern.

At the engine room, for the purpose of giving greater strength than appears was originally intended, there are nine new additional intermediate double ribs introduced, and sixteen additional reverse ribs riveted to the original framing, but in no other part did I see the "ribs doubled."

"She is" *not* "double riveted throughout," but in the longitudinal laps only; the butt joints are single riveted to a jointing fillet, and therefore, as there is

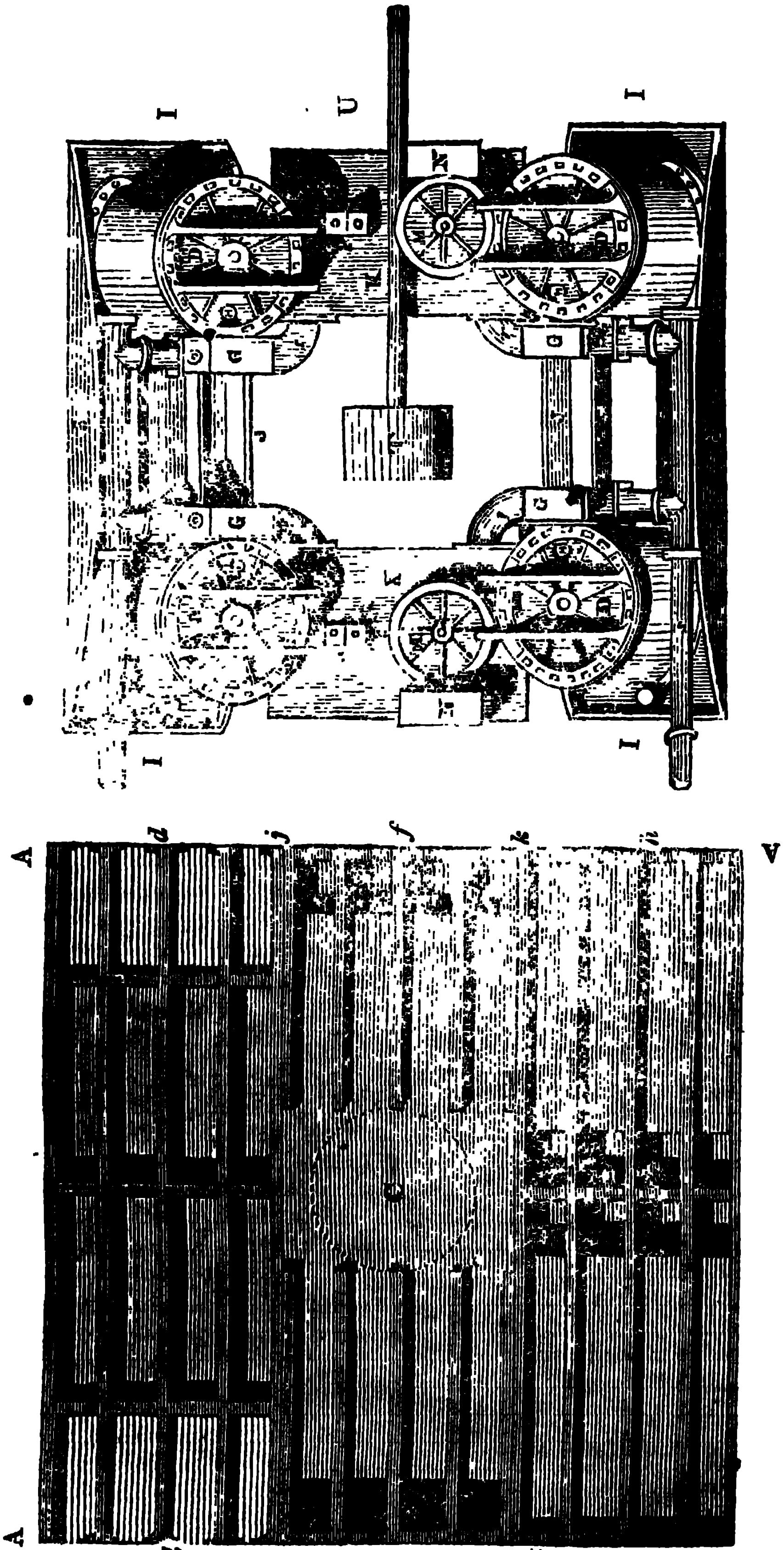


Fig. 3.

but one row of rivets in each plate, it is only single riveting.

I have no disposition to cavil at words or terms, except where they appear not

to express the thing intended, and which seems particularly the case in calling the plate iron vertical supports, for the boiler-platform, by the name of "kelsons," inasmuch, as there is not one of the ten situated in the centre of the width of the vessel, to which situation only does the term apply.

| | |
|---|---|
| Steam power of engines . . | 1000 horses. |
| Stowage for coals . . . . . | 1100 tons. |
| Will accommodate. . . . . | 360 passen. |
| Dining accommodation for | 380 ditto. |
| Crew will consist of . . . . | 130 persons |
| Is to cost, according to a statement made to the public by one of the company's officials, at the time of the Agricultural Meeting . . . | £105,000. |
| But according to the report of the directors at the late meeting of the proprietors, not more than . . . . . . | £76,116. |

The cost of a 46 gun frigate, fully equipped with stores for foreign service, is 39,268*l.* during war,* (from which deduct 20 per cent. for peace rates,) and may be built ready for launching by 61 men in 12 months at the peace rate.

There are to be six masts, on which will, it is said, be spread 1700 square yards of canvass when all set, which is only about $\frac{9}{10}$ths of that of a 46 gun frigate, while the length of the upper deck of the *Great Britain* is about $2\frac{1}{7}$th times, and deck surface $2\frac{1}{2}$ times as much as the above named frigate, though probably the area of the midship transverse section at the load line is very little more in the *Great Britain* than in that of the frigate. The displacement of the frigate fitted and fully equipped for foreign service, is not quite half that given by Mr. Grantham of the *Great Britain*, which is rather more than a loaded 74. The centre of impact of the wind on all the sails of the frigate, where it is concentrated into one point, is about 8 feet before the centre of flotation, and about 62 feet above the load water-line. It is probable that this situation of the concentrated force of wind on the horizontal line, would be found to be nearly in the proportionate situation of a great many paddle-wheels in steamers, and to be the position of most advantageous effect whether impelled by the wind on sails, or by the resistance of the water against the paddle-wheels, though it cannot be used as an argument against the stern situation of the screw propeller, provided the vessel's head can be kept as steady and with as little detraction from the "ship's way" arising from the use of the helm, as if the impelling force were "forward of midships," but of which there appears no record of satisfactory experiments.

I have been informed by a gentleman who witnessed experiments made with the *Archimedes*, that he has seen the helm "lashed a-midships" in calm weather, and water still, when she has made a perfectly straight line, and which proved, it is alleged, how easily the steering could be effected; but to my mind, it proved nothing of the kind, though it did prove, that the centre of the screw was in the centre line of the plane of greatest resistance and immersion. Had any other result been obtained in such a proportionately long and fine vessel, it must have proceeded from some extraneous or disturbing cause.

The mould lines of the *Great Britain*, and of her general construction, as well as the minutia and details of minor parts, appeared to be in beautiful proportions and harmony; and without pretending to much judgment in such matters, I may venture to say, that considering the materials used in construction, having to provide capacity and strength for powerful engines, and a form the most suitable for stern propulsion, as also to attain great speed, and other consequent circumstances, that the symmetry and gracefulness cannot be surpassed, and reflect the greatest credit on the nautical draughtsman (I believe Mr. Paterson, of Bristol,) for having given the lines of construction for as elegant a piece of marine architecture as can be found in any part of the globe. At the same time I know not that this eulogium applies to the flatness of the sides from the engines for a considerable distance upwards, but think it probable that such a departure from a more graceful curve may have been decided on from an idea that the flatness (which appears a defect) may be the more efficacious in preventing rolling in a heavy sea, provided the centre of gravity of the whole mass, when equipped for a voyage, should be found to be in a favourable position. The entrance from

* According to Mr. Edge's most able calculations of ships of war.

Fig. 4.

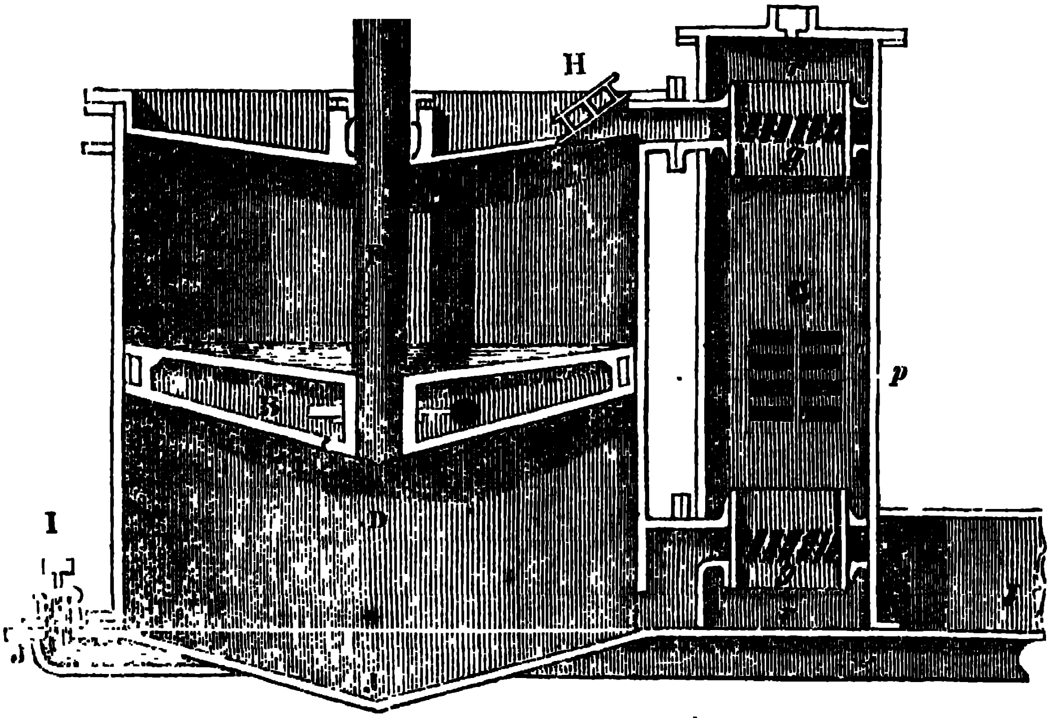



Fig. 5.

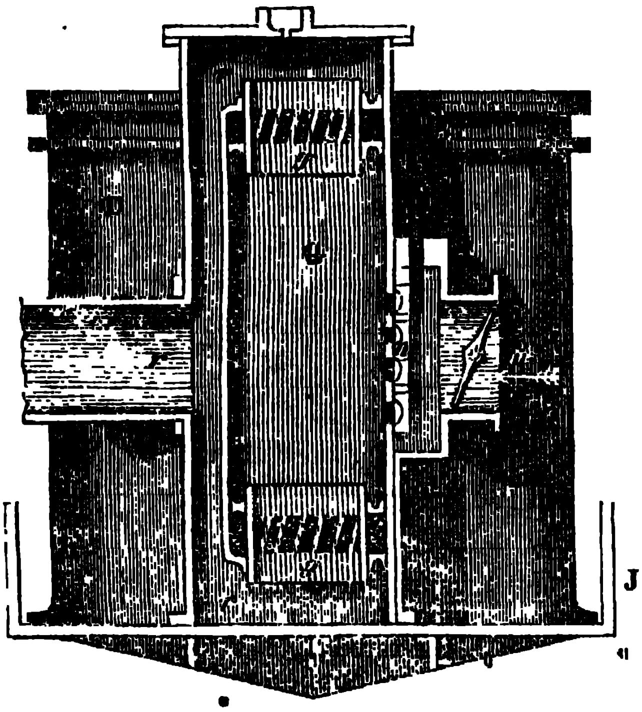
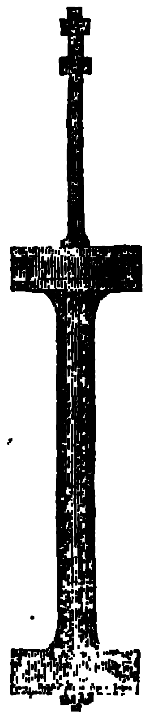



Fig. 6.

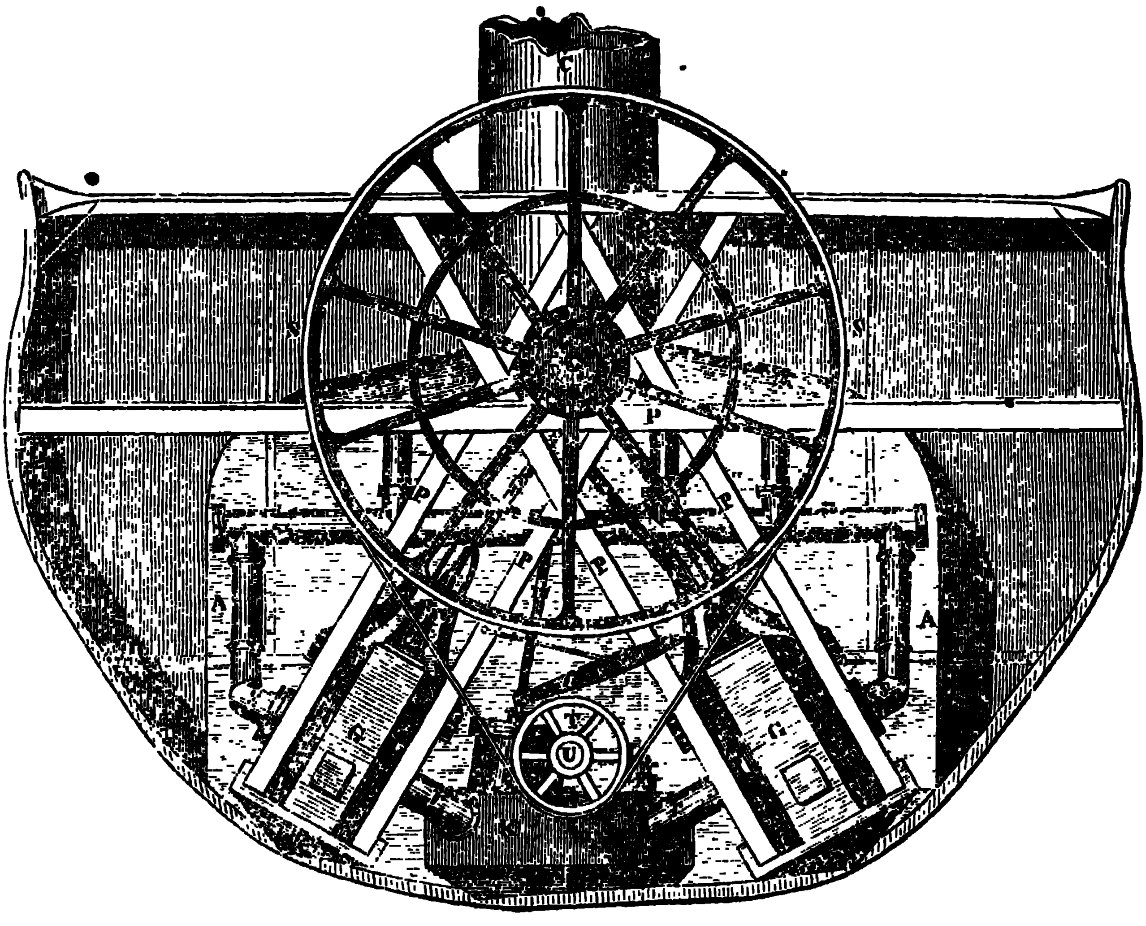


the "fore foot" upwards is very fine, and calculated to displace the water easily, and the "run" very thin. The whole of the materials and workmanship, both of ship and machinery, appear to be of the first order.

Whilst the Scotchman is clamorous for the honour of the Clyde, and the Cockney for the Thames-built steamers, with the steam appliances to boot, I think the Bristolians have also a claim to particular distinction; and although they may not work so *fast*, they certainly work as well as any of their contemporaries; and considering the geographical position, as well as local advantages of Bristol, it is to be regretted that their mechanical advances have not been so great as at other places, and particularly so by the effect of recent events.

The advocated dogma of "cods-head and mackerel tail" of former days in ship building appears to be passed away. Certainly nothing remains of the cods-head, and but little of the mackerel tail, in the case under consideration. A fullness in the midships, for the peculiar construction of engine, was necessary; from this to the extreme point of the bows seems admirably adapted for cutting the waves and going easily through the water, and probably approaches as near the figure of "least resistance" as possible, while, at the same time, a consideration of the vertical sections forward will show that there is little to be apprehended of its being a "wet ship." The bulk of displacement being greatest about the centre of gravity of the vessel, there will necessarily be much less disturbance by the waves, and a shorter voyage thereby to New York than by the "full bow," though in the same track. The artificial bow of dead water in front of the "cods-

Fig. 1.




head," which is to the present day insisted on by some nautical men, must surely be a fallacy.

The beams or joists for the support of the several decks, are bars of apparently 3 inch angle iron, with a joist bar of $5 \times \frac{1}{2}$ inches riveted on the side—distance generally of the joists from 2 feet 4 inches to 3 feet. The deck planks are fastened to the angle iron by screws from below. These angle iron bars are firmly secured at each end to the vertical ribs, which will afford a support to the sides in resisting both external and internal pressure, and are supported in their length by longitudinal beams and stanchions. To provide against the possibility of the entire structure springing or bending horizontally, there is placed between the angle iron bars and deck planks a series of diagonal flat tension bars, forming a continuous horizontal truss from end to end in each principal deck, riveted to the angle irons at the crossings and at the ends.

On the angle iron beams of the lower decks there is an iron plate of from 2 to 3 feet wide by half-inch thick, running

along against each side of the vessel, the edge of which is fitted up against the ribs and riveted on to the flat angle iron beams. This continuous plate is made of the ordinary boiler plates, united at the end with a jointing fillet "single riveted" to each, and over it are laid the deck planks, to which they are bolted; it being therefore firmly secured between the beams and planking, cannot fail to aid very materially in resisting any sudden and partial resistance externally, and to maintain the original form.

The upper, or main deck, is planked longitudinally 3 inches thick in the middle, 6 inches near the sides, from which there is a mass of timber forming the "water ways" increasing from 6 inches to about 2 feet in depth against the outside plating, forming a curve surface against the ship's side above and below, to admit of which, the iron beams are bent down at the ends. The planking of the first saloon deck consists also of longitudinally laid planks 6 inches wide, 4 inches thick, with "water ways" 10 inches thick at the sides; and, as it lies on the before-mentioned horizontal plates, the projection is all above the surface of the deck. The planking of the third deck runs across the ship, with 6 × 4 inch water ways, as in that immediately above.

Mr. Grantham thinks that cabins, decks, masts, &c., will ultimately be made of iron. To decks made of iron plates I think the sailor would have a very *standing* objection, and iron fittings for cabins would not be very consistent with the requirements of refined society. Mr. G. has entitled himself to great credit for having given the subject of iron ship building a most interesting and masterly investigation.

Mr. Fairburn says, that plate iron will bear a strain of 22½ tons, in the direction of its fibre, per square inch, and still more across the fibre; while the Franklin Institute make it rather less, as any one would from common experience expect, but this does not materially affect the present inquiry. He also says, that double riveting is stronger than single, in the proportion of 70 to 56; or, the strength of plate being 100 single riveting, will be 56 and double 70 respectively. A plate 2 feet wide × $\frac{5}{8}$ thick will bear a strain in the direction of its length of 337 tons, and at the joints, if single riveted, 189 tons, both vertically and horizontally (the plate being nearly of equal strength in both directions), whilst it will require, in a timber-built ship, fir planks of about 4 inches thick, to be of equal sectional strength, and which will be making no allowance or deduction for the butt joints. In this comparison of strength, I have entirely disregarded the frame timbers in timber-built ships, and ribs in those of iron, and shall only consider each as forming the frame work. A horizontal seam of rivets as above, if 100 feet in length, will bear a strain of 9150 tons, whilst the strength of a plank joint, independent of the trenails (which places both under the same condition), is nothing.

This absence of union and strength in the planking joints of timber ships is the primary cause of their weakness, and but for the friction and compression caused by the caulking, in horizontal planking, would be much more so. To this circumstance, chiefly, may be attributed the "hogging" or dropping of the extremities of a ship by the unsupported overhanging ends, on its being launched and taking its immersed support on the water, which I have understood has occasionally amounted in ships of war to from 8 to 10 inches.

The diagonal planking of Seppings is admirably calculated to make a much better use of materials than the former plan, for by the planks crossing each other, and forming an infinite number of triangles with the apex downwards, and the upper parts being united by strong tension stringers—probably the strongest wooden fabric possible is obtained. This observation may raise the question (much easier asked than answered), why it is that the diagonal plan was not in use much earlier, since every boy who rides on a five-barred gate knows that without the diagonal his horse's head would drop? The very best combination of wood, or of wood and iron, that can be devised, appears, however, very far below the strength which may be obtained by plates of iron in forming the hull of a ship.

The greater capacity of an iron-built ship will also be a matter of considerable importance; as, from the absence of floor and frame timbers, kelsons, linings, deck-beams, and knees, the stowage will be materially increased over a timber ship, though the external dimensions be

the same, and which, in the *Great Britain*, I imagine would not be less than 1000 cubic yards.

As the form may easily be maintained by internal framing, bracing, and trussing, what is there to limit the size of ships, except the draft of water in ports, mercantile convenience wharfs, quays, &c.? I do not see any reason connected with the construction, or in an engineering point of view, why the *Great Britain* may not hereafter be considered an ordinary sized vessel, instead of being "outrageously large" as she is now called.

There may be more advantages obtained by large steam vessels than at present occur to me, but I will mention what appear some of the most prominent. The greater the length of a vessel the greater will be the broad-side resistance against the water, and consequently less "lee way" will ensue, and less will be the disturbance by waves from a straight line, and consequently, the velocity will be less detracted by the water impinging against the rudder. Adverse storms and heavy seas will be of less consequence, and such as would founder moderate size ships may be regarded in a large one as insignificant. The displacement, and therefore capacity of the vessel increasing as the cube, whilst the section of resistance increases as the square of dimensions, it follows that a less proportion of power to tonnage will be sufficient. Large engines and large fires will work more advantageously than small ones. The friction of parts generally will increase as their diameters, whilst the areas under pressure of useful effect will increase as the square of the diameters, and twisting or torsion as the cube of the diameters. Radiation of heat also from the surface of boilers, steam-pipes and cylinders will follow the same law.

What the durability of iron plates in a sea vessel may be, does not appear to be very clearly established. Mr. Mallet says, that a half-inch plate will last 100 years exposed to sea water, but it must be considered that the inside of the bottom of a ship will be exposed to the bilge-water, and therefore the period will be reduced to 50 years. If in 50 years a half-inch plate be half worn away on the outside by corrosion, and the other half be reduced to an oxide on the inside, it is perfectly clear that it could not form part of a ship, even 25 years, when the average thickness would be reduced to ¼-inch; besides, corrosion will not go on uniformly, some parts will be nibbed quite through, whilst others will be much less affected. This is a matter requiring more research.

But of all the patent plans for the "galvanization of iron" to prevent oxydation, brought forth a few years since, I do not know of one that is in use.

The first iron steamer, as appears by Mr. Grantham, was the *Aaron Manby*, constructed by the Horsley Company in 1821, and I am pleased to see that she is still in use, from the circumstance of having been present at Horsley when the parts were shipped into the canal boat. My recollection of the thickness of the plates is imperfect, but I have an impression that they were not more than $\frac{5}{16}$ths, if even so much, and that all the joints were flush. Mr. Grantham thinks that "plates may probably be yet required of much greater strength than ⅞ths of an inch thick." Surely no peaceful maritime occupation can require it, and as good citizens of the commonwealth we ought no longer to indulge in forming plans to defeat cannon balls, for which only, or "hammering on rocks" can such a thickness be required. If larger vessels than the *Great Britain* are built, and more strength be considered necessary, the most advantageous disposition of it would be in *ribs and bones and not in the skin.*

*The Machinery.*

The boiler, as will be seen by the accompanying sections, presents a great quantity of surface to the action of the fire and heated air, and appears amply strong for condensing engines.

In wooden-built steamers there is an absolute necessity to guard against the possibility of the timbers taking fire; and for this reason the boilers have been constructed with water spread *all over* the surface of the bottoms below the fires; but as the same necessity does not exist in iron vessels, it occurs to me that the entire quantity of boiler plates and water below the line of the fire-bars, but for the deposition of salt, is *useless and unnecessary*. It is not to be supposed that any portion of the current of flame will *dip down* at the back of the bridge and impart heat to the *sides*, even much less will it touch the bottom, and then creep

Fig. 7.

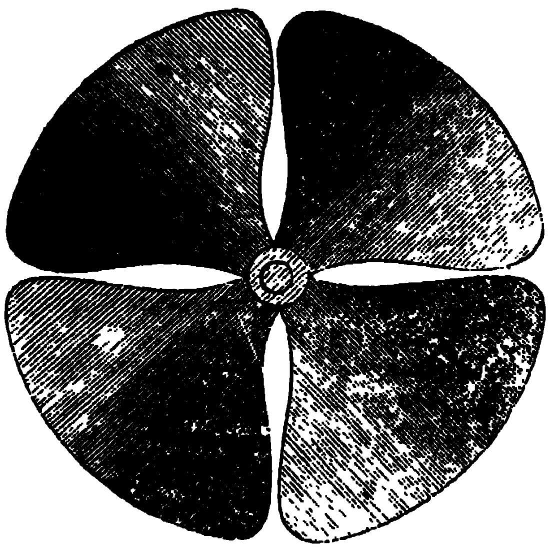


Fig. 8.

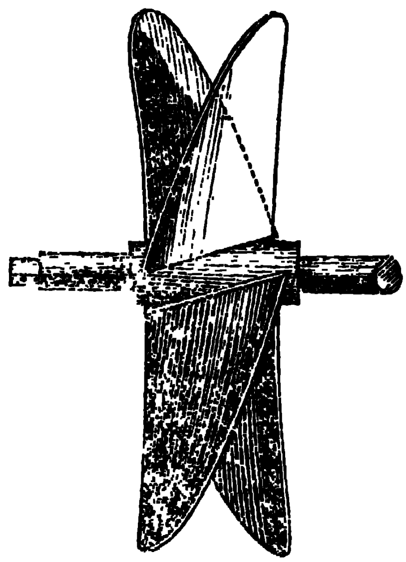


Fig. 9.

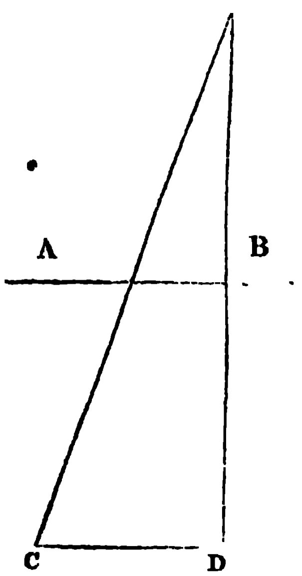
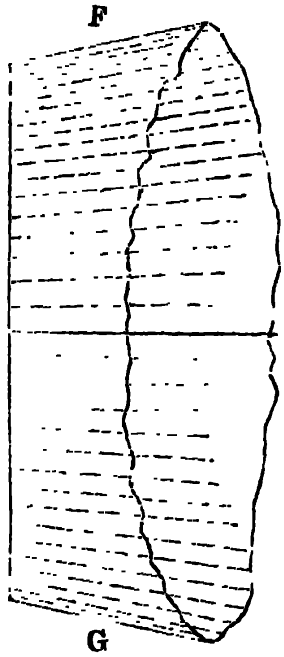



Fig. 10.




up against the back before it escapes to the upper flue; the cause of the air being drawn into the fire, being the inferior specific gravity of that contained in the chimney, caused by its expansion by heat; and as the *drawing* power of the chimney extends to the fire, the centre of the current of heat will take the *shortest course* (except, that some trifling deviation will take place in the curves of the currents at the bends of the flues), and all flue space to which the current does not extend, will be occupied by the heavy carbonaceous gases in a quiescent state, possessing a *very small* power of transmitting heat from the current to the flue plates. I believe in almost all cases of boilers with large flues, by far the greatest quantity of heat is imparted to the water by the roof of the fire-place, and flues, and my present impression is, that were all that mass of water, amounting to probably not less than 2,500 cubic feet, or about 70 tons weight, and nearly 40 tons of boiler work removed, and the bottoms of the flues made good in another way, the heating power and effect of the boilers would be still nearly equal.

If this view of the question be correct, there is then also a sacrifice of space under the boiler of about 20 feet long, by the width of the ship, and at least 6 feet

high in the centre, which might have been available for spare sets of engine work (if it be intended to carry such,) or other heavy stores, which would compensate for the centre of gravity of the boiler being raised, should that be considered an object.

It will probably be said, that this boiler space is necessary for the reception and subsidence of the salt, and that less would not do. But it would still appear that, were the whole of the bottom raised up to about a level with the top of the bridges, some advantage in heating would be obtained, a considerable space be gained for other purposes, and ample room be left for the subsidence of the heavy saline water, combined too with an equally effective arrangement for "blowing off."

*The Engines.*

I find it is still believed by some persons that the engines are to be constructed on the "trunk principle" of the late Mr. Humphreys; but such is not the case here adopted, but rather approaching the patent plan of Sir Mark Brunel, at least in the position of the cylinders, except that instead of the cylinders making a right angle, or 90° with each other, they stand at an angle of 60°, or thereabouts. From the dimensions and particulars already given, your readers will have so far become acquainted with this branch of the subject as to render it superfluous to do more than advert to such additional details as appear to possess novelty, and may therefore be interesting. It will be observed, that the foundation plate has a conical depression of about 12 inches, into which the piston dips; this depression fits into the bend of the ship, and is therefore taken advantage of in depressing both faces of the piston, and also dishing the cylinder cover to about eight inches at the centre, thereby affording the connecting rod to be that much longer. The piston is cast with its top and bottom face, arms, and outer ring, in one piece; and for the purpose of fitting in the keys to fasten the rod there are two holes, into one of the spaces between the arms, through which the fitting and fastening is performed, and which holes are then stopped by circular plates, with valve mitre edges, and made fast. The rubbing, or "metallic" surface of the piston, is one ring of cast iron, cut open at one point, with a half-lapped joint, depth 7 to 8 inches, to be packed behind. The nuts for holding down screws for the packing ring are turned cylindrical, and inserted into holes of 2½ inches diameter, drilled in the top of the piston. The holes to be expanded by heat, and the nuts inserted cold, so as to be held in by friction, and probably farther secured by a tap screw, but this I did not notice. How much better this plan may be than either mortice or dovetailed nuts, I am not prepared to say.

The piston rod is forged with an eye at the top for the connecting pin, and the lower end in the piston is parallel, or nearly so. The guide frames for the top of the piston rod are fixed to the cylinder cover.

The shells of the piston valves are brass cylinders with steam openings, as shown by the sections, having a "twist," apparently for the purpose of causing the wear to be more uniform. On the outside of this brass casing there is an annular chamber leading to the cylinders. The piston valves are also each furnished with a cast iron expanding ring, as before described, for the cylinders. (Had my old friend, the late talented Arthur Woolf, adopted an arrangement of this kind in his "steam plug" to his small cylinder, he would have been more successful.) This form of valve, side pipes, &c., makes a convenient arrangement, but still leaves the question open as to whether it is better, if as good, for large engines, as the lantern valve of another scientific gentleman (of whose kindness and urbanity I have a very grateful recollection,) the late Jonathan Hornblower.

These valve pistons are to be worked by eccentrics in the usual way; but I understand the "reversing" is to be effected by an 8 feet spur-wheel being attached to the eccentric, with a pinion to slide into gear with the wheel, on the spindle of which pinion there is to be a spoke-wheel, similar to a tiller-wheel, and the eccentric is to be driven by the main shaft through the intervention of a "sliding clutch."

The expansion valves are similar to the sliding ventilators used for admitting hot air into buildings, and there being four openings in the length of the valve, the orifice opened for the admission of steam to the valve pistons will be four times the length of stroke of the valve, whatever

hat may happen to be. Throttle valve of the usual kind. The air pumps (brass lined) are to stand partly in the condensers, with the foot valves at their lower ends. Air pump rods (iron, brass cased) have also an eye at their upper end for the connecting pin. The connecting joint of the air pump is kept in its right line by parallel motion rods, by one set of which are moved the boiler and bilge pumps. The connecting rods of two cylinders and of one air pump are attached to the same crank pin, and the bearings on the crank pin are turned spherical.

The most extraordinary part of the whole machinery, and more particularly deserving notice than any other, is the wrought iron main shaft, made at the Mersey Iron Works, Liverpool. In the rough it appeared quite sound, and nearly as well hammered as an anchor. I have also seen it since it was turned, and partly bored, but did not understand there were any serious defects in it, though it was said to be "hollow" in places.

The model exhibited to the public has its cranks in opposite directions from the centre of the shaft, and which the exhibitor said was correct; I have therefore drawn them so, although it is probable a better position will be found. It also exhibited a plain *strap* driving-wheel on the main shaft, with a pulley below on the screw spindle, which, it was said, is to make 80 revolutions per minute; but it appears that the method intended to communicate the power from the engines to the screw, as also the construction of the screw, is not yet decided on, although it was said to be "all *settled*."

The whole of the work appears extremely well executed, the details to have been considered with great care and judgment, and the proportions, with some exceptions, are well maintained. When finished, and set to work, I have no doubt they will prove good engines.

In all combinations of machinery, there are reasons for preferring particular arrangements; and should the screw propeller prove as effective as has been spoken of, the reasons for this arrangement of machinery will be sufficient to entitle it to public approbation; but, otherwise, I believe it will be admitted, that any position for a large steam cylinder, *out of the vertical*, makes but a second-rate affair.

The condensers being of more than the usual proportions, may be expected to make a more uniform vacuum than is generally found to exist; and to produce a better *test card*, though perhaps not higher, or even so high as the "patent best" of 36 inches.

I saw none of the endless schemes of which so much was said yesterday, and so little will be known to-morrow. Still, if schemes be not introduced, we cannot reap the benefits. For instance, the patent condenser, with its 14 miles of ½-inch pipe, and 40,000 joints, saving 15 per cent.—patent boilers, 25 per cent.—patent fuel, 30 per cent.—smoke burners, 35—rotary engines, 40—patent engines with slots in the sides and trunks in the middle, besides all that never-ceasing variety of patent paddles and patent propellers, (one screw that is to be excepted,) calling into use so many high-sounding names, and flourishing more geometry than Euclid ever dreamed of. Think of the boundless wealth which must accrue to that man who would be bold enough to amalgamate all these elements into one vast machine, that would require so much *less than nothing* to keep it going, and have "oceans" of power to spare!

Here would be a "mammoth" indeed!

I will not prolong this paper by discussing the merits of the screw as a propeller, or trouble you with an opinion; besides, neither you nor your readers want it, for you have them of all shapes and sizes, and to suit every purpose and fancy.

There are decided disadvantages inseparable from the use of the paddle-wheel system, such as the great weight of upper works, shafts and engine framing, wheels and framing, paddle-cases, and a variety of ponderable matter, all tending to keep the centre of gravity in an elevated position; greater exposed front surface to head winds, or side surface with wind on the beam, and with the lee paddle immersed to a great depth, and the other frequently whirling in the air; loss of steam power, arising from the obliquity of paddles in entering and quitting the water, forcing some below and throwing much above the surface; from the great immersion of paddle-wheels on leaving port with a full cargo, and too little when light; strain and tremor from machinery running through the upper part of the

vessel, and consequently the necessity for greater strength in the upper works; besides the inconvenience to passengers and crew, arising from not having a clear deck and clean sides.

The disadvantages of the screw are generally of a different kind, perfectly free from those attendant on the paddle-wheels. Until an efficient rotary-engine be forthcoming the reciprocating piston must be used, and as the number of revolutions produced by reciprocating engines will be found nearly in the inverse ratio of their nominal power, it is clear that the *revolving* speed will be much less in large engines than small ones; hence, a difficulty will arise in producing such a combination of machinery for converting, say 18 alternations of great intensity of power into a great number of revolutions as shall be effective, lasting, and not objectionably unpleasant to the passengers. Spur or bevel geer wheels will effect the purpose; but then, there is the continued clatter of iron tongues. Straps will do, provided they be wide enough, or if narrow, strong enough: but let us see how the matter stands.

Assuming as data:—

Power given to main shaft 1,000 horses, or 33,000,000 pounds.

Piston to travel 216 feet, producing per minute 18 revolutions.

Circumference of driving wheel 80 feet, will give for the velocity at circumference of driving wheel per minute, 1,440 feet.

Strain at working or pitch line, 22,900 pounds, will require, if iron spur geer, according to good practice, and if a 4 inch pitch be adopted, that the width of the wheel or wheels (if divided) be about 45 inches. If by strap, belt or combination of ropes of any description on plain surfaces, the width being 5 feet, and circumferential contact on pulley 6 feet, that the tightness be such as to produce an adhesive contact on each square foot of 766 lbs. (The atmosphere is said to assist in the adhesion of straps, if so, in what way, and how much?) Or it would require, if of common leather strap, according to good durable manufactory practice, that its width should be, 67 feet 6 inches, which is not much above half the width for single straps.

Have you not lately written, Mr. Editor, that there is some new plan for such a purpose, by the use of *plain surface contact?* He ought to be a wise man who will say it is impossible, yet perhaps *there are* such daring spirits.

Although I apprehend there never has been a band, or strap, used in the slightest degree approaching to what is here required, still I am of opinion that such a combination of materials may be produced as would accomplish the purpose: I will therefore dismiss the question as being one of *surmountable* difficulty.

The stern stuffing-box cannot be said to be a difficulty, though it has been urged as an objection and disadvantage consequent on the plan, and so, indeed, it is, to a small extent. I presume it will be considered advisable rather to permit a small quantity of leakage (which under such a head of water need be very trifling) than by making it water tight, thereby increase the amount of friction. The whole available power of 1000 horses being communicated to the spindle, and from the spindle to the screw, causing it to revolve, but which is given back to the spindle again in another shape, that of *pushing forward*, it is clear that the whole force is transmitted from the "inboard" end of the screw to the vessel, and as both the power and velocity will be considerable (making not less than $1\frac{1}{2}$ million turns in a fortnight's steaming), the surface of the end of the spindle, as also what it pushes against, are matters of no trifling amount, to be free of undue friction and of durable materials. The journal of the spindle as well as the socket of the rudder stern post must be of such materials as are the least likely to suffer by abrasion in sea water, and with as little friction as possible.

And "last, though not least," but by far the greatest, comes the screw. In order that a vessel may be propelled 10 miles an hour by the screw, I understand it is found that the progressive velocity of the screw must be 12 miles an hour, or $\frac{1}{5}$ forward faster than the vessel, and supposing such to be correct, or thereabouts, and that the screw makes 80 revolutions per minute, the pitch of the screw (or, perhaps, the base of the inclined plane will be an expression as well suited) must be $\left(\frac{5280 \times 12}{60 \times 80}\right)$ = 13 feet 2 inches, whether it be a complete one entire thread, similar to the first Archimedes, two half-threads, similar to the present Archimedes (which I find is 6 feet diameter by 5

feet long each), or similar to the *Great Britain* model, and shown in figs. 7 and 8, still it but slightly affects the present inquiry. Allowing the diameter of the Great Britain screw to be 15 feet, the diameter of the circle of effect would be about 12 feet 6 inches, or 39 feet 6 inches circumference; therefore the mechanical constructions, if developed to a straight wedge, would be represented by A B, fig. 9, line of axis; C D, distance passed over by one revolution (13 feet 2 inches); D E, circumference of circle of total effect; and C E, acting face of the screw. The amount of resistance caused by the friction or adhesion of the water on the face of the screw will very much depend on the smoothness of the surface; or, probably, a thin disc of water will be carried round with the screw, and the friction take place amongst the particles of water at some slight distance from the face. F G, fig. 10, shows the divergent lines of the cone of motion communicated to the water, and, if the above premises be correct, it appears to promise a greater effect than has generally been expected, inasmuch as the direction of impact of the screw does not make so great an angle from the line of the axis.

I think this mechanical construction will prove to be not far from the truth. As, however, I am merely describing the character and quality of the drawbacks on each plan, I will leave the question of their amount to other and abler heads, but I consider that *one practical fact, one fair experiment*, with both plans, in which *every possible circumstance* and contingency shall be as much as possible alike, so that the result cannot be questioned, is worth more, for settling a matter involving so many intricate conditions and calculations, than all the algebra that was ever strung together.

All the machinery is in a forward state, and a great part ready for putting into the vessel. The boiler is nearly finished, and in the joiners' work, of cabins, berths, &c. considerable progress has been made, but it is impossible to give an opinion as to the time when she will be ready for sea.

In daily life occurrences happen which are called accidents, but I am a little sceptical that such is a proper term for most of them. I know there are many acts of carelessness from which frequently disastrous consequences ensue. Accidents at sea, and land, too, there are, but they are from elements beyond our control, and therefore

> "The best laid schemes o' mice an' men,
> Gang aft a-gley."

I know not either that the "vasty deep" could furnish forth from Vulcan's workshop, even with mermaids' help to boot, such appliances as would repair an accident to screw, shaft, or bearing, for be it remembered there can be no "tightening up bolts," no examining bearings, and other little attendances which all machinery either has or ought to have; but if any thing be wrong the vessel must go into dock, and be laid dry as low as the spindle at least, except there be means provided for slinging, unshipping, and lifting it over the stern quarter, though the whole of the stern machinery is so simple, and of such few parts, that derangements ought to be few, if any, and should such occur may probably be examined by the use of a diving-dress and rope.

The *Great Britain* is being constructed in a dock excavation, to which an entrance is in progress of building, which is to be closed by a floating caisoon. The bottom of this dock is 12 feet below the surface of the water in the harbour, and as her bottom stands a working height above the bottom of the dock, it is purposed to pump water to a higher level than the harbour, so as to remove the supports and allow her to drop and to be floated out.

It is contended by many nautical men, and some eminent in the profession, that the situation of the propelling force being at the stern will cause the vessel to run very wild in a head wind, and to counteract which the rudder will be in such constant requisition as to cause a considerable loss of power; but, as I said before, *one sound and settled fact* is worth a thousand opinions.

Taking all circumstances into consideration, it does appear that if by the use of *an equal weight of fuel* the "duty" performance of the screw be *nearly* equal to that of the paddle-wheel, and that the whole of the machinery be so constructed as to be lasting, and not unpleasant to passengers, it has the merit of being free from some serious inconveniences of the paddle-wheel, such as, great top-heaviness, opposition of the paddle-boxes to

the wind, &c., and possesses these advantages besides, namely, that strength in the upper part of the ship is not required to support machinery, and that the deck is clear—a great comfort to passengers, and of great convenience in management of sails and working the ship.

I understand it is the intention of the Directors to use *wire* standing rigging, which appears admirably adapted for the purpose from its being less in size, and therefore presenting less surface when under "bare poles," from its being lighter than rope, strength for strength, from its greater durability—for if oxydation be prevented there seems no limit to it, and from its maintaining nearly a permanent length, and not requiring frequent "setting up," as is the case with rope, and probably it is more particularly applicable to iron vessels than wooden ones, from the rigidity of the former not requiring the elasticity that may be serviceable in the latter.

There being two plans lately brought forward for the protection of ships from lightning, I may be permitted to say a word or two on that subject, as it is by no means an unimportant consideration. Mr. Snow Harris, of Plymouth, proposes to *let in* a slip of copper to the side of the masts, from the highest point of the main-top-mast, and to continue the same to the deck, and through the ship to the water. Mr. Andrew Smith, of London, uses copper wire rope, from the same point aloft, but brought down by the sides of the shrouds and crosstrees, &c., direct to the ship's side, and then, if in wooden vessels, to the water, or to the copper sheathing. The advantage of the latter plan over the former appears to be as follows. Electric fluid is conducted over the *surface* of metallic substances; and, as a slip of copper may be so divided into wires as to have its original surface increased from ten to one thousand fold, it is clear that a very much less quantity of material, formed into wire, will be equal in its conducting power. The *continuity* of a rope is much easier maintained, at the interruptions of caps and crosstrees, &c., and by its being led direct over the side by the shrouds, there is not that liability of interruption to the electric "circuit" which would ensue to slips of copper at the masts, crosstrees, decks, &c. We have lately witnessed serious "accidents" by lightning to buildings; but may not some part of it be found to have had its origin in the conductors being broken, of an insufficient surface, and perhaps scarcely ever thought of? On land, there are innumerable points and projections forming conductors (though mostly imperfect) which assist to restore the equilibrium between the clouds and the earth, when in contrary electrical states; but it is quite easy to imagine millions of acres of clouds highly charged with electricity, either positive or negative, floating over the sea, ready to commence war with the waters beneath, if in the opposite electrical condition; and should a solitary ship be near, unprovided with good and sufficient conductors, the probability is that an "accident" would happen.

On commencing this task, I intended to confine myself to a faithful, straightforward, though concise description of this vessel, without departing either to the right or left in extraneous matter; but I find I have rambled a little out of the line of description, and into comparisons and investigations; though, having no prejudices or interest either way, my only aim has been to afford your readers a *correct account* of the magnificent *Great Britain*.

I remain, Sir, your obedient servant,

J. R. HILL.

98, Chancery-lane, August, 1842.

## IRON LIGHTHOUSES.

Sir,—It is just six years ago since I addressed you on the subject of an improved iron lighthouse, on a principle altogether different from any which had ever before been presented to the public; and the advantages which were proposed to be gained by it, were stated to be manifold and of the very highest importance, inasmuch as by its adoption, thousands upon thousands of pounds worth of valuable property, as well as numbers of our fellow men, who brave

"—the dangers of the seas,"

might be annually saved from perishing. The great novelty of the idea, which was then presented for the first time to the public (as might be best gathered from the very rude sketch which accompanied my letter, and which you inserted at the commencement of your 26th volume), was the adoption of a mode of construction by which all the enormous force

which is exerted on the shaft of ordinary lighthouses by the destructive violence of the winds and the waves, would be entirely got rid of by elevating the keeper's house and light room to a height sufficient for the purpose, *on a metallic column of about two or three feet in diameter only*, which was proposed to be kept in position by chain cables in the manner shown in the sketch. In lieu of chain cables, however, it occurred to me shortly afterwards, that tension rods of wrought iron would be preferable; and in a finished drawing, which I subsequently sent to you, these tension rods were shown, which circumstance, I have no doubt, Mr. Editor, you well remember.*

This mode of construction I stated to be much *stronger* than the old one; and, at the same time, (which is a matter of the greatest moment,) much *cheaper*.

Up to the present moment, I am not aware that any of your readers, or correspondents, have called in question the correctness of the principle, or any of the statements which I then made: on the contrary, I think that its excellence has been publicly acknowledged in the erection, by the Corporation of Trinity House, of the lighthouses on the Maplin Sands, and at Fleetwood on Wyre; and although these are not constructed exactly in the manner which I proposed, wood being employed both for the column and stays instead of iron (and, according to my judgment, in a very clumsy manner), yet the grand principle which I advocated, namely, that of having the structure *open to the sea*, so that there is nothing for the waves to be exerted upon, has been most triumphantly established.

These experiments (for experiments they can only be called) have more than ever convinced me of the value of the invention, and of its practicability; and laying claim, as I believe I am justly entitled to do, to an invention so valuable, and which promises to be so useful, I would henceforth undertake to construct lighthouses in *any* situation, whether on a sand bank or on a rock, for one-tenth of the sum which any stone one would cost, in less than one twentieth part of the time, and which should be at least ten times stronger!

* Perfectly.—Ed. M. M.

From the praiseworthy efforts which you have ever made on behalf of the rights of inventors, I am emboldened to ask the insertion of this letter in your highly valuable journal, satisfied that the invention is one from which innumerable blessings must ultimately flow, not only to this country, but to the whole maritime world.

I am, Sir, yours, &c.,
JOHN LAKE, C. E.

August 31, 1842.

## PURE WATER v. IMPURE CISTERNAGE.

Sir,—The subject of "Filtered Water" is again *agitated*, and the legislature is to be called upon to enquire, 1. Whether the Water Companies *have* effectually filtered and purified their water, to the extent of their engagements? 2. Whether the water supplied *may not be* further improved? 3. Whether it *ought not to be* so improved? I am not going to forestall the result of these enquiries, or to furnish an answer to them; but I cannot help calling the attention of your readers to a common sense view of these matters, which I have never seen taken by any public writer on this question.

The proposition with which I shall set out is, that in almost every case, the water at present supplied by the several companies, whatever may be its state of comparative purity, is materially deteriorated before using, through want of cleanliness on the part of the *consumer*. If a master sends his servant to the spring for water, she is careful to take a clean vessel to bring it in; and she is much wiser in her generation than her master, who continually receives comparatively clean water in a very dirty vessel. The receptacles for water mostly used in London consist of cisterns of lead or slate, and wooden butts. Of these, the slate cisterns are the most cleanly, and the butts the reverse. In many of these receptacles the water is never wholly changed, nor the containing vessel cleansed, from one year's end to another; and in a still larger number of instances, only when the water becomes so thoroughly contaminated as to be positively offensive.

During the prevalence of a hot summer, a few years since, a friend of mine, with all his family, were taken very ill; their medical attendant could not at first

detect the reason, although it evidently sprung from some common cause. On my taking him into the yard, and raising the loose cover of the water-butt, and exhibiting the living mass of corruption it contained, the cause of illness was apparent. The butt was immediately emptied and cleansed, and the patients soon recovered.

This butt was a very large one, and the consumption of water in the family seldom lowered its contents more than a third; the water was supplied every day, so that a very large portion of water always remained unchanged. The butt stood in an angle of two brick walls, exposed to the full force of a meridian sun, with an apology for a cover. The consequence of all this was, that in summer weather the contents of the butt teemed with life.

Now, this party is one of the greatest sticklers for "filtered water," and runs far and near to put his hand to petitions against that "evil race"—the Water Companies. If the legislature were to ask this advocate for pure water—whether the water supplied may not, and ought not to be further improved? he would answer, "most certainly it ought!" altogether forgetting, that nothing that the Water Companies can do will avail against his own inattention and want of cleanliness. This person is only one of a very numerous class.

It must be admitted on all hands, that the water as at present supplied to the metropolis, contains a certain quantity of impurities varying in quantity and character with the change of seasons. This quantity, however, bears no assignable proportion to the great mass of impurities which collect within our cisterns, &c., from extraneous sources, and the water which was originally supplied in a good and wholesome state, becomes adulterated and contaminated to a very serious extent.

The remedy for this state of things is simple enough if the public would only give a little attention to the subject. The frequent emptying of the cistern would of itself do much towards keeping the water pure; but the occasional application of a besom to the sides and bottom would remove *all* objectionable matters, and ensure perfect sweetness.

While upon this subject it may not be amiss to observe, that clearness of the water is somewhat influenced by the time of day at which it is supplied. When the supply is given early in the morning, the contents of the cistern and any obnoxious matters it may contain, become incorporated with the fresh supply in mechanical admixture, and do not subside for some hours, during which time a continual draught is being made upon the cistern for domestic purposes; whereas, when the water "comes on" in the evening (as it does in my own dwelling,) a most effectual filtration by deposition goes on during the night, and the water becomes beautifully clear and bright by the time it is required for daily use.

Again, many elevated cisterns are supplied from one in a lower level by a pump, which is generally set to work while the water is coming in, and is consequently in its very worst state. Where the lower cistern is sufficiently capacious to admit of such an arrangement, the upper cistern should be pumped full an hour or two *before* the water comes on, so as to take the water in its purest state.

Should the questions proposed ever be put to the Water Companies, I think they may very well reply by putting another, and asking, whether the arrangements of the present system of cisternage do, or can be made capable of doing, anthing like justice to increased efforts upon the part of the Water Companies to increase the purity of their fluid? A question I am sorry to say that cannot be truly answered in the affirmative.

It is highly desirable that the inhabitants of London should be supplied with water in the purest possible state, in sufficient quantity, and at a moderate cost; but it is quite evident that any increased labour and expense incurred in purifying the water will be completely thrown away, unless the consumers will, in their turn, pay much more attention to the cleanliness of their receivers than they have hitherto done.

I remain, Sir, yours respectfully,
Wm. Baddeley.

September 1, 1842.
29, Alfred-street, Islington.

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THE NEW STEAMER "QUEEN."

Sir,—May I beg the favour of being allowed to make a few brief remarks on the letter of "Veritas" (p. 199.) First, I do not see that there is anything in my letter to justify the remark of your correspondent,

that "according to L. P. it has been reserved for another new prodigy, the *Queen*, to outstrip all former productions and compeers, and again to beat the poor *Railway*." The *Railway* is said to be the fastest river boat plying on the Thames; consequently to try the speed of a new steamer with any other would show a want of confidence, and, when done, amount to nothing. The question asked by most parties interested in river steaming, is, "can you beat the *Railway?*"

Again, your correspondent observes, "I think L. P. admits that the victory was in some measure to be attributed to the number of passengers the *Railway* carried at the time." I beg to say that I admit nothing of the kind. The *Railway* on her passage up had no more passengers than was necessary to give her proper trim, no more than the *Queen* would have gladly taken under the like circumstances. That the *Queen* was in good condition there can be no question, and who, knowing anything of the Engines of the *Railway*, would say that the *Railway* was not in good condition? Seeing that the engines are not only of first rate manufacture, but have undergone a thorough repair the early part of this season.

In reference to that part of your correspondent's letter, wherein he states the *Blackwall* beat the *Queen*, I am of opinion he has made out a very poor case. He says, that the *Blackwall*, in a run of twenty miles, gained from three to four minutes upon the *Queen*. But how has he come to that conclusion? By taking it for granted *that the Queen did not stop*, and that because the *Blackwall* got to Gravesend three or four minutes after the *Queen*, she therefore gained so much on her? Now "Veritas" is here quite in error. The *Queen did stop*, and did not only stop, but went much out of her course to bring up at Rosherville Pier; and after going a-stern to bring up at the pier, she again went on her journey to the Nore. The *Queen* had on board about seventy persons, and at least 5 tons more coals than necessary to take her to Gravesend and back, which would be quite equal to the load of the *Blackwall*.

But I must beg leave to inform your readers, that the *Queen* has tried her speed with the *Blackwall* in a much more fair way. On the 12th of August, the *Queen* went to Gravesend, and brought up alongside the *Blackwall* at the Terrace Pier, and started with her at half-past 12. The *Blackwall* had not more than thirty or forty passengers, but of course these would prevent her going! However, either that or something else did; for although she was blowing off steam strong all the time, the *Queen* passed her, and went round her head in long reach, returning to Gravesend to try the *Isle of Thanet*.

In this second trial, however, I freely admit the *Queen* was beaten; but I consider there is no more credit due to the *Isle of Thanet* for beating the *Queen*, than there would be in a man of 15 stone weight, beating one of 10 stone. Let the respective engineers furnish an indicator diagram, and state the diameters of cylinders and lengths of stroke; it will then be seen that I am justified in coming to this conclusion.

I am, Sir,

Your obedient servant,

L. P.

August 29, 1842.

## DR. PAYERNE'S DIVING-BELL EXPERIMENTS AT SPITHEAD.

On Friday, the 2d instant, Major-General Pasley went out to Spithead to inspect the operations against the wreck of the Royal George, and, at the same time, to perform a promise he made some time ago to Dr. Payerne, to afford him the means of proving whether his invention for producing pure air fit for the respiration of man, and for supporting flame, without communication with the external air, which he had so often successfully exhibited in London, in the diving-bell of the Polytechnic Institution, would be equally efficient at Spithead. Of this great doubts were entertained by the General on his first interview with Dr. Payerne, after having witnessed his performances at the above-mentioned institution, for, as he told the Doctor, though he was satisfied that he could produce good air at any depth, the pressure of from 12 to 15 fathoms of water at the bottom of the anchorage at Spithead would compress the air in a diving-bell so much, that though men might exist in it, they would not be able to work to advantage; being nearly up to their necks in water. Therefore, unless the doctor could get over this difficulty his ingenious and novel invention would not be attended with any practical benefit, at least in deep water, as it would not dispense with the necessity of still using an air-pump to expel the water from the lower part of the bell, according to the system hitherto in use. Dr. Payerne, who at that time was not possessed of any experience in diving, his first attempt having been made at the Polytechnic Institution, was not prepared for this difficulty; but, having afterwards fully considered it, he adopted an expedient for removing it, which proved completely successful on giving it a fair trial at Spithead, as we shall now proceed to relate. This con-

sisted in filling four iron cylinders with condensed air, which was forced into them by a small air-pump, until the gauge proved that the pressure was equal to nine or ten atmospheres. These cylinders were four feet long, and about a foot in diameter, with hemispherical ends, being the same that had been used for containing condensed gas during the period that the Portable Gas Company was in operation. Each of these cylinders held about three cubic feet of compressed air, and the whole were lashed to the bottom of a wrought-iron diving-bell, made two years ago by Mr. Taplin in Portsmouth dock-yard, according to the dimensions prescribed by Major-General Pasley, to be used over the wreck of the *Royal George*, if required; but which had not yet been done, as it was found, contrary to previous expectation, that helmet divers were far more efficient than bell-divers could possibly have been. When the preparations were completed Dr. Payerne took his seat in the diving-bell accompanied by Major-General Pasley, who, having full confidence in the goodness of the Doctor's air, but less in his expedient for keeping out the water from the bottom of the bell, took the precaution of putting on a watertight diving dress, offering another to the Doctor, who rejected it, in the belief that he would be able to keep the bell completely dry. They had, however, scarcely descended more than 10 or 12 feet below the surface when the water came in upon them so fast that the Doctor requested that the bell should be hauled up out of the water, as he said he was sure that it must be leaky. This was done accordingly, and on letting it down empty his assertion was found to be correct, for the air issued rapidly from the top of the bell, in consequence of the cap over the hole, through which air would have been forced down in the common mode of using the bell, not having been screwed on tight enough. This defect being remedied and the bell let down empty a second time, there still appeared a slight leakage from the lower part of it, which was so inconsiderable that Dr. Payerne and the General went down a second time, the former having put on a diving dress also. One of the air cylinders had been emptied in their first descent, so that only three were now available, the contents of which they let into the bell by turning the cocks at the end of each, so that when they descended to the depth of 12½ fathoms, or 75 feet, the water only stood about 6 inches high in the bottom of the bell, when they were hauled up by mistake of a signal before they had quite reached the bottom. After this, Lieut. Hutchinson, the executive engineer employed at Spithead about the *Royal George*, and Mr. Hardiman, Dr. Payerne's assistant in the mechanical and engineering branches of construction connected with his inventions, went down together, but as the slack tide was nearly over, they would not wait to have the cylinders filled again with compressed air, which could not have been done in less than an hour. They were, therefore, obliged to make the signal to stop lowering, after they had only descended 23 feet, the bell being at that time nearly half full of water, which was gradually increasing upon them, owing to a small leak at one of the rivet holes in the lower part of it.

On Saturday, the 3rd inst., the same experiments were repeated, but in the presence of fewer spectators, and the diving-bell had by this time become perfectly water-tight. Dr. Payerne and Major-General Pasley went down twice—first to the depth of 12 fathoms and a half, when they were pulled up by mistake of a signal before they reached the bottom, to their great disappointment. After the four cylinders were filled again with compressed air, which was done in about an hour, they descended a second time, and as the men above had strict orders not to stop lowering until the diving-bell reached the bottom, and not to haul it up again, unless they pulled the signal line three or four times, Dr. Payerne had the satisfaction of getting a small piece of wood from the wreck of the *Royal George*, after which they made the signal to ascend. Another experiment, of still greater interest, was tried at the suggestion of Lieut. Hutchinson, who went down without any air cylinders, accompanied by Mr. Hardiman, having the end of one of the diver's air-pipes with them, through which air was forced into the bottom of the diving-bell by one of the small pumps which usually supplies air for a helmet diver. By means of this pump the water was expelled from the lower part of the diving-bell, and replaced by condensed air, which enabled them to descend to the very bottom, there being no cylinders to prevent the bell from taking the ground, as in the former experiment; and Mr. Hardiman also brought up some small relics from the wreck. Some uneasiness was caused, both to them whilst at the bottom and to the men above, by its becoming impossible to communicate with signals, in consequence of the signal line becoming entangled with the bell rope, by which the bell had been let down.

The result of these experiments is, that both Major-General Pasley and Lieutenant Hutchinson expressed their high opinion of the merit of Dr. Payerne's invention, as applied to the diving-bell; for they consi-

dered that the air they breathed in the bell was perfectly good; and the whole apparatus for purifying it was contained in a case not larger than a common portable writing-desk, which gives no trouble but that of turning a small winch or handle occasionally; and as, besides water, two very cheap and simple ingredients only are used, the manipulation requires no science on the part of the person in charge; and, when the diving-bell is once filled with compressed air, either by letting it escape from vessels previously filled with it, as in the first experiment, or by four men pumping for less than half an hour, as in the second experiment, no more pumping is necessary, as the air in the bell never requires to be changed. In the common mode of working the diving-bell, on the contrary, a powerful pump, manned by six or eight men, would be required at Spithead, which must be kept constantly at work the whole time that men are down in the diving-bell; and this incessant pumping is so laborious that from twelve to sixteen men, working in two reliefs, would be necessary for the purpose of expelling the water.—*The Times.*

## ABSTRACTS OF SPECIFICATIONS OF ENGLISH PATENTS RECENTLY ENROLLED.

JOHN HALL, OF BRAZIER'S-HILL, RATCLIFFE-HIGHWAY, SUGAR REFINER, *for improvements in the construction of boilers for generating steam; and in the application of steam to mechanical power.* Enrolment Office, June 9, 1842.

The patentee has, by a disclaimer, entered with the Clerk of the Patents, June 9, 1842, disclaimed the following words in the title of his patent:—"And in the application of steam to mechanical power." The patent is therefore now restricted to the "improvements in the construction of boilers for generating steam;" and these improvements consist simply in "constructing steam-boilers of two or more parts, in such manner, that the parts can readily be separated one from the other, in order to the more readily cleansing of the flues and tubes of such boilers."

JOSIAH TAYLOR, OF BIRMINGHAM, BRASS FOUNDER, *for improvements in the construction of lamps.* Enrolment Office, June 9, 1842.

The lamps to which the present improvements relate are all such as are used for burning "wax and fatty matters which are not in a liquid state in the ordinary temperature of the atmosphere of England;" and the improvements consist in placing below the cup, or other reservoir containing the wax or fatty matters, another vessel containing hot water, or hot pieces of metal, by which the former are melted and kept in a fluid state.

JONATHAN GUY DASHWOOD, OF RYDE, IN THE ISLE OF WIGHT, PLUMBER, *for improvements in the construction of cocks and taps.* Enrolment Office, June 9, 1842.

The peculiarity which is the subject of this patent is described as consisting in "fixing a valve upon a tube, or part of a tube, and causing the valve and tube to rise and fall at one and the same time, so as to allow the fluid to pass under the valve, and then through the opening into the inside tube." As well as we can understand the invention from the specification of it, which is very obscurely worded, it has some resemblance to that of Mr. Jeffree, described in our 992nd Number, p. 145; the present patentee employing one tube within another, with suitable orifices, to effect that which Mr. Jeffree accomplishes by an external slide-valve, removable at pleasure. The latter is evidently the preferable arrangement.

THOMAS STARKEY, OF BIRMINGHAM, COPPER CAP MANUFACTURER, *for improvements in percussion caps for discharging fire-arms.* Petty Bag Office, June 16, 1842.

These improvements consist in making use of a double cap, with the fulminating powder between them. The outer cap is of the same form as usual; but the powder, on being deposited in the end of it, is covered over with a disc of tin-foil. A smaller cap is then inserted within the other, having a small hole at the end, exactly coincident with the touch-hole in the nipple of the gun, in order that the fire from the explosion may pass through it to the charge of gunpowder within. The two caps are then drawn together, and united into one entire cap by the means ordinarily used for drawing percussion caps. The small hole in the inner cap is also covered with wax or varnish, to exclude wet. The advantages claimed for this cap are, that it is secure from damp; that the detonating powder cannot be shaken out; and that the flame produced by the percussion is more concentrated.

WILLIAM CARRON, OF BIRMINGHAM, LATHE-MAKER, *for improvements in clogs and pattens.* Enrolment Office, June 21, 1842.

These improvements are five in number.

1st. A clog is described which is made with a flexible metal sole, and the forepart, or tread, divided into three parts; so that the flexibility of the former may allow of the latter bending freely at the points of separation.

2nd. Another clog is distinguished by

having a thin flexible plate of metal, extending from heel-piece to the tread, to which it is affixed at the fore part only, "so that the plate may bend in walking notwithstanding the length of the tread."

3rd. A third clog is remarkable only for the manner in which the heel-piece is attached to the sole-plate (of a thin flexible plate of metal as before). The plate is screwed into the heel-piece, and on its under side there is a spring which takes into a recess in the heel-piece, "by which arrangement," it is said, "the heel will at all times have a tendency to remain at the shortest length."

4th. The next improvement consists in forming the caps of the fore points of clogs and pattens in tools without cutting the leather of which the toe caps are formed. "I sink a cavity, by preference of iron, though wood or other hard materials may be used, such cavity being of the form of the exterior of the toe cap of a clog or patten, and I make another tool or *force* convex to the form and size of the interior of the caps. The leather is to be cut into a suitable size and immersed in warm water, and when in a soft state it is to be taken out and rubbed over with *dubbing*, oil and grease. The leather is then placed over the concave mould, and the convex tool forced in, compressing the leather between the external surface of the convex tool, and the under surface of the convex mould. The leather is to remain in other tools till sufficiently cold, and may then be japanned, as leather is usually japanned (when japanning leather is used,) before making it into caps for the toes of clogs, as heretofore practised."

5th. In constructing the irons of pattens, it has been usual to make them of rings, the lower surface of which, coming to the ground, rests on the same plane. The object of the patentee's fifth and last improvement, is to apply irons to the fore part of pattens, which are highest towards the back end, and "at the front end approach the toe with curved surfaces," whereby, it is expected, "that persons using such pattens will be materially convenienced in walking."

Edward Hall, of Dartford, Kent, Civil Engineer, *for an improved steam-boiler*. Rolls Chapel Office, July 11, 1842.

The present invention consists in adding one or two side tubes to an ordinary tubular boiler, so as to extend the heating surface, and produce the effects of a larger boiler, without augmenting the space ordinarily occupied by one of smaller size. Those external, or, as they are called, "feed-heating tubes," are placed in the side flue or flues of an ordinary cylindrical tube boiler, and are connected to the boiler as well as to its lower fire tubes, and the water made to circulate through them, as afterwards explained.

The patentee states that, in carrying this improvement into effect, he does not find it necessary to confine himself to any particular dimension of boiler, or number of tubes, or attachment of them to one another; but by preference makes each of the two feed-heating tubes of the same size as the lower tubes, and about the same length. "In their construction I prefer fixing each of the two feed-heating tubes to the boiler at both ends, making them an integral part of the same; then connecting these tubes to the lower tubes by a flanched neck towards each end, which are secured together with screw bolts." He does not claim the use of the feed-heating tubes in the flues of boilers generally, as they are known to have been used before; but he claims their application to cylindrical boilers with tubes below them in the fire, as new, that is, feed-heating tubes connected with the tubes beneath cylindrical boilers, and interposed between them and the boiler, without the feed water which passes through them, being allowed to mix with the water of the lower tubes in its passage into the boiler. It is in such application and arrangement that he grounds his patent "for an improved steam-boiler," which having within itself the means of heating its feed water approaching to or exceeding the point of ebullition, is productive of very considerable economy in the fuel necessary for generating a given quantity of steam, compared with boilers without such an appendage.

George Haden, of Trowbridge, in the County of Wilts, Engineer, *for certain improvements in apparatus for warming and ventilating buildings*. Rolls Chapel Office, August 16, 1842.

The improvements which are the subject of this patent consist in the adaptation or application to the external sides of stoves, grates, or other warming apparatus, of certain metallic plates, or zig-zag pieces, which being cast on to, or otherwise fixed to the sides of the stove or grate, increase the extent and effect of the heating surfaces, and cause currents of air to pass with considerable rapidity in close contact with these heated surfaces, the air thereby becoming warmed, and which warmed air may then be conducted to any room or apartment that may require to have its temperature raised. A sheet of drawings is appended to the specification, representing various modes of carrying the patentee's views into effect. The first exemplification given is that of a close stove, of a rectangular form. The surfaces

of the top and four sides of the stove are directed to be furnished with four plates of metal, which may vary in projecting depth from 1 inch to 12 inches, or more, according to the size of the stoves, and may be arranged in any directions, and at any angles with reference to the sides, that may be found convenient. The sides of the stove being furnished with any number of these plates, and arranged in any convenient manner, the stove is to be covered or surrounded with a casing of any suitable material, which, as it must touch the outer edges of the projecting plates, will form a number of zig-zag channels. Through these channels atmospheric air is conducted from below, through apertures made for that purpose. As metals of all descriptions are known to be good conductors of heat, the projecting plates, which are connected to the sides of the stove, soon become heated by the fire within, and the air being obliged to pass in narrow streams between these plates, soon becomes warmed, and, on arriving at the top, may be conducted off, through a pipe or flue, to any apartment that requires warming, or may be allowed to pass at once into the room which contains the apparatus. Straight or bent plates are equally applicable, and the apparatus may be also employed for diffusing heat derived from hot water, or from steam or gas. The patentee prefers that the projecting plates should be cast on to the sides of the stove, so as to form a component part thereof; but he does not confine himself thereto, "as they may be affixed to the side of the stove by hard solder." The air to be warmed is to be admitted to the apparatus through suitable holes or apertures made at the lower part of the casing, or in its bottom, and which air, in passing up the narrow channels, becomes warmed, and ultimately escapes at the upper part, through similar holes or flues, or may be conducted off to some other apartment, as before mentioned.

Pure atmospheric air may be supplied to the apparatus by means of pipes or flues leading from the outside of the building, and, by thus causing a constant draught, ventilate the apartment.

One of the principal advantages derivable from this invention is stated to be, "the increased extent of heating surface which is obtained by the application of the projecting plates, whereby a small stove may be made to give out as much, or more heat than one of larger dimensions, having plain sides, as at present made."

*Claim.*—"I claim the application of projecting plates, or pieces placed in zig-zag ranges, and at any angles, on the sides or surfaces of grates or stoves, or other apparatus for diffusing heat by radiation and rapid circulation of the atmosphere."

OSBORNE REYNOLDS, OF BELFAST, IRELAND, CLERK, *for certain improvements in covering streets, roads, or other ways with wood, and also in the means of enabling horses and other animals to pass over such roads, and other slippery surfaces, with greater safety than heretofore.* Rolls Chapel Office, August 22, 1842.

These improvements are divided into two parts, and consist, firstly, in various improvements upon a former invention, for which Mr. Reynolds obtained a patent on the 27th of April, 1841, for "improvements in paving streets, roads, and ways," and secondly, in a novel method of making the shoes of horses and other animals, to prevent them from slipping, and giving them a firmer hold on the pavement.

"In order to form a firm, compact, and cheap pavement," the ground is first levelled and rammed hard, and also covered with sand if desirable. Upon this are laid boards, planks, beams, laths or slips, parallopipedons or other figures, such as may be formed by one cut either oblique or perpendicular from a plank of any breadth, and of any thickness not exceeding four inches. Blocks may also be used, formed similarly from round or unhewn timber. If desirable, a second, or even a third layer of boards may be placed on the first, embedded wholly or partially in cement, and nailed, or otherwise fastened together. Between the sides of blocks which are in contact, a few grains of gravel or other hard substance, not smaller than spheres whose diameter is $\frac{1}{20}$th of an inch, may be interspersed, so that these grains may be partially embedded in each of two adjacent sides, and thereby strengthen their mutual support. To make the pavement water-tight, the blocks are surrounded with cement, and to unite the whole compactly together, the blocks are secured to the foundation planks, or to each other or both, by nailing or pinning each block to the mass already formed. "This method of fastening the blocks together," says the patentee, "is obviously different from any of the methods hitherto employed of securing a number together by means of pegs, pins, or dowels." To roughen the surface the inventor scatters upon it by the hand or some hand instrument, gravel or broken stone, screened so as to contain neither dust, nor sand, nor grains of any size less than that described above. This gravel is scattered in any quantity not exceeding 4 lbs. avoirdupois to the square-yard, and the operation is repeated often enough to keep the surface constantly rough; this repetition, combined with the use

of grains of a proper size, alone produces the whole effect desired without the accumulation of mud or dust, which always accompanies the use of gravel as it has been hitherto employed for this purpose.

To prevent horses from slipping, bars, ribs, or projections are formed on that part of the under side of horse-shoes, which is between the toe and the caulk.

*The Claims are, firstly,* To the method described of using boards for a foundation of wood pavement, also to the use of blocks of the forms described; together with the modes described of strengthening the whole by means of hard grains of gravel, nails of iron, or pins of wood; and further, the method described of roughening the surface continually by gravel or broken stone.

*Secondly,* To the improved method of constructing the shoes of horses and other animals, whereby they are prevented from slipping.

WILLIAM NEWTON, 66, CHANCERY-LANE, MIDDLESEX, CIVIL ENGINEER, *for certain improvements in regulating the flow of air and gaseous fluids.* Rolls Chapel Office, August 23, 1842.

These improvements consist in a "peculiar construction of apparatus, in which, upon the slightest increase of pressure from the air or gas which passes through the apparatus, the flow of the air or gas is restricted and regulated in a novel manner, until the extra pressure has ceased."

The working parts of the apparatus are contained within an outside metal casing, which is supplied with a moveable lid or cover. An annular moveable bell-shaped vessel is placed in the interior of the metal casing, covering an aperture by which the gas or air enters the bell-shaped vessel, and through which its throw or passage is regulated by means of the conical end of a hollow tube, which is suspended by means of a metal rod or chain from the inside of the bell-shaped vessel. The aperture for the admission of the gas or air is formed at the upper circular end of a metal cylinder, which is supported by an annular chamber or gallery, and when once placed in its proper situation, it remains stationary, and is prevented from moving laterally, or out of its position, by small blocks. The apparatus is supplied with water from above, by removing the lid or cover, and its level inside is seen by means of a glass tube outside. All the different parts of the apparatus that are to be filled with water are made to communicate with each other; and when the apparatus requires emptying, the water is allowed to flow out through an aperture to which there is a screw tap. The bell-shaped vessel is suspended by rods or chains from the ends of levers, and the weight of the vessel, together with the hollow tube, is counterbalanced by weights at the opposite ends of the levers. Gas or air flows into the apparatus from a supply pipe, and passes up one annular passage into the upper part of the bell-shaped vessel, whence it passes down another annular passage, and finally escapes from the apparatus through a pipe. If the pressure of the air or gas into the apparatus is too great for the consumption, then it presses on the surface of the water, and against the domed part of the vessel; thereby causing the latter to rise and draw the conical end of the hollow tube up into the aperture, and contract the same, and not allow so great a quantity of gas to enter. When, by the issue of gas from the apparatus, the equilibrium or proper pressure is restored, then the vessel sinks again, and allows the conical end of the tube to descend also from the aperture, and permit the gas to enter.

*Claim.*—"I claim, first, the peculiar arrangement of apparatus herein shown and described, or any modification thereof; and, secondly, any apparatus for regulating the flow of air or gas, in which such regulation is effected by means of a conical plug, or the conical end of a tube, either hollow or solid, rising into the aperture through which the gas passes, and thereby closing, or partially closing the same, and preventing the air or gas from passing, as above described."

## INSTITUTION OF CIVIL ENGINEERS.

### MAY 21, 1842.

"*Description of the Maplin Sand Lighthouse at the Mouth of the River Thames.*" *By John Baldry Redman, Grad. Inst. C.E.*

The paper commences with an enumeration of the various channels and sandbanks at the mouth of the Thames, with the floating lights, beacons, and buoys marking the entrances of the Channel, and gives the objections to floating lights and the reasons for selecting the Maplin Sand as the position for a fixed lighthouse.

In the year 1837 a survey was made by Mr. Walker, the engineer to the Trinity House, and by boring it was ascertained that the first 6 feet of the sand was close and compact, but below that for 20 feet the boring rod went more easily as it descended, and it was found that it became mingled with argillaceous earth as the depth increased.

It was then decided to use for the foundations Mr. Mitchell's screw moorings, and in 1838 the patentee, under Mr. Walker's directions, commenced fixing nine cast-iron

screws of 4 feet diameter, so as to form an octagon with one screw in the centre: attached to each of these screws was a cast-iron pile 5 inches in diameter and 26 feet long, which was inserted into the sand 21 feet below low-water mark. On account of the constant shifting of the sand from around the piles it was determined to place a raft or grating of timber around and between them: the surface of the raft was covered with faggots of brushwood well fastened to the timbers, and upon them was deposited 120 tons of rough Kentish ragstone, by which the raft was secured in its situation, and after a time no farther changes occurred in the level of the surface of the sand.

In the summer of 1840 the superstructure was commenced: it consists of nine hollow iron columns or pipes, curved at the top to a radius of 21 feet towards the centre; they were secured upon the piles, and two series of continuous circular horizontal ties bound them together, while they were connected with the centre column by diagonal braces—all of wrought iron. Upon these columns is built a wooden dwelling for the light-keepers, in the upper part of which is placed a French dioptric light of the second order, its centre being 45 feet above the mean level of the sea, and at that elevation can be seen from a ship's deck at a distance of nine or ten miles; a bell is fixed on the gallery which is sounded by machinery at intervals during dark and foggy nights.

The communication gives all the details of the dimensions and the mode of fixing the cast-iron screws and piles made by Messrs. Rennie—the iron-work by Messrs. Gordon of Deptford—the woodwork by Messrs. Gates and Horne of Poplar, and the lantern by Messrs. Wilkins—and the whole is illustrated by a series of drawings which fully describe this useful construction, which has hitherto withstood the most violent attacks of the sea to which it is exposed.

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In answer to questions from the President, Mr. Wilkins stated that he had been in the Eddystone and the Maplin Sand lighthouses during severe gales of wind: that, as might be conceived from the nature of the construction, the latter building was more affected than the former by the striking of heavy seas: the motion appeared to be more like torsion than simple vibration, which he attributed to the waves striking the ladder and its projecting stage, and thus tending to twist the upper part. Still the motion was not such as would cause injury to the building.

The President pointed out two diagonal braces extending downward from the end of the ladder stage to the piles on either side, which had been introduced in order to counteract the twisting described by Mr. Wilkins. In constructions of this nature it was of importance to oppose as little resistance as possible to the seas, especially in the upper part of the building, a system of bracing had therefore been adopted which consisted principally of two series of continuous circular horizontal ties between the piles at the several heights of 6 feet and 15 feet above low-water mark of spring tides. From the external ring of piles two sets of diagonal stays extended to the centre pillar, forming strong triangular trusses in the direction of each pile, and two sets of horizontal stays stretched between the piles and the centre pillar at the levels of the circular bands. The amount of direct vibration was very small, and he did not conceive that the twisting motion which had been described was sufficient to warrant the introduction of diagonal braces, which would materially augment the surface upon which the waves would act.

Mr. Vignoles directed the attention of the meeting to the system of diagonal bracing between the piles which had been adopted at the Port Fleetwood lighthouse; he apprehended that as the principal force of the waves would be exerted against that part of the structure which was above the high-water level, the diagonal braces extending between the upper part of the piles and the level of low-water were preferable to the horizontal continuous bands of the Maplin Sand lighthouse, although assisted by the system of radiating central truss braces which it possessed: he conceived that both buildings were strong enough for the purposes for which they were constructed, but he preferred the mode of bracing adopted in the Port Fleetwood house, the vibration of which he knew to be very small, although situated in an exposed position where the rise of tide is 30 feet.

Mr. Donkin observed that there could not exist a doubt of the introduction of diagonal braces rendering the building stronger; how far they were necessary or might be prejudicial in offering additional resistance to the passage of the waves should be well examined before adopting them. He considered the position of the suspended ladder decidedly objectionable, as any torsion caused by the waves striking it must tend to dislocate the fibre of the material of the piles and to fracture them.

Mr. Farey believed the construction of the Maplin Sand house to be better adapted than the Fleetwood house for resisting the direct action of waves, but the diagonal bracing of the latter enabled it to withstand torsion better than the hoop bracing of the former. He inquired why the lower part of

the light-keeper's house was made conical, as he apprehended that it would receive a heavier blow from a wave than if it had been flat.

The President replied that the main body of the waves seldom or never rose so high as the bottom of the house, and that the conical form allowed the air and spray to rise up and be guided off without affecting the building, as it would do if the bottom was flat.

With regard to the torsion, that had only been felt at first when the ladder extended too low down and received a constant succession of blows from every wave, which naturally communicated a vibration to the whole structure: the ladder was now shortened and nothing of the kind was felt; the waves scarcely, even in the roughest weather, struck the suspension stage or the boat. He preferred the continuous horizontal bracing, which bound all the piles firmly together like the staves of a barrel; and from observations he had made he believed the amount of vibration to be greater in the Port Fleetwood lighthouse than in that at the Maplin Sand.

In answer to a question from Mr. G. H. Palmer, the President said that at present there was not any indication of a change in the condition of the cast iron from its contact with the salt water.

Professor Brande was unable to give any additional evidence on the observed facts connected with the change suffered by cast iron exposed to the action of salt water, or in mines and in various other positions—from experiments which he had made, he was led to believe that many of the appearances observed in the changes of cast iron arose rather from a peculiar mechanical combination of the molecules, than from a difference in the chemical constitution of the metal: no difference could be detected by analysis in the metal which had undergone change and that which had not.

It should be remarked that the contact of two metals was not essential to cause galvanic action; a film of oxide upon the surface of the body of metal formed a very active galvanic pile: hence arose the necessity for preventing oxidation by proper paints or varnish before using pieces of cast iron in exposed situations.

Mr. Farey observed that in the early engines constructed by Woolf in Cornwall, in which the packing segments were of gun-metal and the body of the piston was of cast iron, wherever the two metals were in contact the iron was turned to plumbago: this had been particularly observed where high-pressure steam was used: it might be a question whether the temperature of the steam, and the quantity of mineral water carried over with the steam by the large amount of priming of the engines in that day, had not materially contributed to produce the effect.

Mr. P. Taylor believed that the temperature of the steam had not any connexion with the subject: in the metallic packing of steam pistons of low-pressure marine engines, which he had constantly under repair at Marseilles, wherever the wedge-pieces were of gun-metal, the backs of the cast-iron segments were converted into plumbago, whilst those surfaces of cast iron which were ground together and worked against each other remained unchanged: the same might be said of the rubbing surfaces of cast iron against gun-metal; it appeared therefore that the formation of an oxide was necessary to commence the change. He repudiated the use of cast iron in situations where these changes were to be apprehended; he would employ wrought iron, as although that did become oxydized, it retained its relative strength to the last, whereas cast iron when changed into plumbago, retained its bulk but lost nearly all power of cohesion.

Mr. John Taylor said that in Cornwall the cast-iron pump-trees exposed to the action of mine water were very speedily destroyed; and even although 1½ inch thick they could be cut to pieces with a knife when first taken out of the pit. The air-pump buckets of steam-engines, in which the body was of cast iron and the valves of gun-metal, formed the most perfect kind of galvanic apparatus; they should be made entirely of gun-metal.

In manufactories of vinegar and pyroligneous acid the decay of cast iron was very rapid.

Mr. Glynn attributed in a great degree the rapid decay of cast iron in coal mines to the presence of sulphuric acid evolved from the pyrites.

Mr. Philip Taylor agreed with Mr. Glynn: even copper pipes were rapidly destroyed in the bilge-water of vessels which always contained much sulphuretted hydrogen—he recommended the use of stout lead pipes in such situations; they would be found much more durable.

Mr. Davison had found it necessary to substitute gun-metal gratings for the cast-iron ones at Messrs. Hanbury's brewery, as although they were ¾ inch thick they had been entirely destroyed in four years.

The President gave a short account of the construction of a lighthouse now making by Messrs. Gordon and Co. at Deptford, under his directions, for the Point of Air. The lantern for it would be cast from a gun which had been raised from the wreck of the Royal George.

Mr. C. W. Williams exhibited and explained the sight-tubes which he now used for the marine boilers of the City of Dublin Steam Packet Company's vessels.

The instrument consists of a wrought-iron welded tube 2 inches diameter with a screw-thread cut upon the exterior: it is inserted across the water spaces of the boilers and secured by means of nuts in such positions behind and opposite the furnace, as enables the engineer to see all that goes on interiorly, particularly the degree of perfection or imperfection in which the gaseous matter enters into combustion and the effect of admitting or excluding the air.

The instrument had been found very useful not only in experiments but in practice on the large scale, and he deposited it in the Gallery of the Institution in order that it might serve as a model for those who were inclined to adopt it in marine boilers.

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May 31, 1842.

"*On the construction of Model Maps, as a better mode than Sectioplanography for delineating the Drainage and Agricultural Improvements of a Country, or projected lines of Railways, Canals, &c.*" *By John Bailey Denton, Assoc. Inst. C.E.*

This communication was accompanied by a map in relief of an estate, as a specimen of the method which the author recommends.

The subject of mapping in relief is not new, and the author had previously published a treatise on the subject,* but having made extensive experiments, he was enabled to bring the subject before the Institution in a more defined form, showing that the construction of the models had been reduced to a simple and cheap method. These models are peculiarly recommended for pointing out the capabilities of a district for drainage either for agricultural purposes, or for collecting waters together for manufacturing power. They are superior to maps, as they show at a glance the relative heights of the various points, display the geological phenomena, and may be made to delineate the state of cultivation of the districts. The lines of railways, of roads, or of canals, can be more clearly defined upon them, and they are stated to be peculiarly adapted for parish surveys.

The expense of making a model of an estate of compact form is stated to be from two shillings and sixpence to three shillings and sixpence per acre.

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"*Observations on the Periodical Drainage and Replenishment of the Subterraneous Reservoir in the Chalk Basin of London.*" *By the Reverend James Clutterbuck, &c., &c.*

This paper, which formed the substance of a letter to the Reverend Dr. Buckland, and was by him communicated to the Institution, consists of a series of observations on the periodical drainage and replenishment of the subterranean reservoir of the chalk basin of London, especially that part of it which lies in a N.W. direction between London and the Chiltern Hills.

The author divides the district into two portions, that to the north and that to the south of the river Colne.

The northern portion is mostly covered only with a bed of gravel, through which the rain water percolates to the chalk, in which, being upheld by the retentive strata below, it accumulates until it finds vent by several deep valleys which incline southward, and carry off a large quantity of water by the streams Ver, Gade, Bulbourne, and Chess, into the river Colne, which runs in a S.W. direction under the escarpment formed by the outcrop of the London and plastic clays. The surface of this reservoir or the water level, regulated by these vents, dipping towards the south at an average inclination of nearly 300 feet in fourteen miles, may be represented by a line drawn from the upper district at that angle, and terminating at the river Colne.

The southern portion is almost entirely covered by the London and plastic clays, from the surface of which the rain water flows in open drains and water-courses. A considerable portion of that which flows towards the Colne, sinks into the subjacent chalk, when it arrives at the outcrop of the sand of the plastic clay formation, and assists in the replenishment of that portion of the reservoir that underlies the London and plastic clays. Here the water level, or the height to which it would rise through perforations in these clays, where its continuity is interrupted by them, would be represented by a line drawn from the Colne to mean tide level in the Thames below London, the only apparent vent for their waters. In the upper district, during the replenishment of the reservoir, which usually occurs between December and March inclusive, the water accumulates in a proportion increasing with the distance from the river or vent, and falls off in a corresponding ratio during its periodical exhaustion, which usually takes place between April and November. This alternation of level, which in the upper districts exceeds 50 feet in perpendicular height, would be represented by a line fixed at the river or vent, and rising at an angle proportionate with the increase furthest from it, the extent of its

* Outline of a Method of Model Mapping, by J. B. Denton. Weale, 1841.

rise or fall being determined by the quantity of rain percolating the chalk. The ratio between these extreme points is so exactly maintained, that if the difference of rise or fall in two wells, one near, and another at a distance from the vent be ascertained, the alternation in the intermediate wells will be determined with considerable accuracy.

The progressive rise of the water level is apparent at the sources of the streams which break out at higher levels in the valleys in which they run, or when brooks or burns burst forth and run during a certain period, when the surface of the reservoir attains a certain level, previously to which, the water rises in every depression till it reaches the height at which it can flow away; the converse of the effects which preceded their bursting may be seen as they cease to flow.

When no water percolates the surface of the upper district, the flooding of the Colne by heavy rains, together with the sinking of the water into the chalk at the outcrop of the sand of the plastic clay formation, raises the level in that locality, and by checking the drainage retards the exhaustion of the reservoir. When this occurs during the replenishment, and from continued rain, the level near the river maintains an increased elevation, the water checked in its course towards its vent accumulates in a ratio increasing with its distance from it, a process of adjustment to be traced throughout the district during the replenishment, and conversely during the exhaustion of the reservoir.

The geological condition of the lower portion of the district, together with the paucity of wells, make it difficult to ascertain the extent of the natural alternations of that part of the water level which underlies the London and plastic clays; the difficulty is increased by an unnatural depression caused by the exhaustion of water under London, which is said to increase yearly, and indicates that the rapidity of the demand exceeds that of the supply: the alternation at that point may be from 2 to 4 feet, and is coincident with the rising and falling of the levels in the upper district.

If water be discharged from a shaft in the chalk by a power not capable of exhausting it entirely, the rapidity of the reduction of the level will gradually decrease until it is exactly balanced by that of the supply; when the exhaustion ceases, the level will rise in the inverted ratio of its reduction; if the level be measured in a line from the point of exhaustion, a similar reduction will be found, falling off at an angle decreasing with the distance from it.

The aggregate discharge of water from under London produces a similar effect: daily measurements in one well, confirmed by some coincident measurements in another more than a mile distant, show that beginning on Monday, the level is gradually reduced during the week; the cessation of pumping on Sunday is marked by the rising of the level by Monday morning; if any great quantity of rain falls, a sudden rise or check in the periodical fall takes place; the resumption of any extensive or continued discharge of water may be traced; a general coincidence of rise and fall in different wells is apparent; holiday times, such as Christmas, Easter, and Whitsuntide, may be distinguished. Thus, the measurement of a chalk well in London would show the days of the week and the great festivals, by the daily variations; the seasons would be indicated by the average difference in the height of the level at different periods of the year; and the changes of the weather by the falling of rain, would also be shown.

The chalk under London is of a much closer nature than that in the upper districts; it yields the water sparingly but steadily from orifices beneath those beds or bands of flint which are the most unbroken and the strongest, and from faults and cracks which are frequently met with. The constant and increasing demand not only depresses the level under London, but must accelerate the exhaustion of the reservoir above. When the water level near the Colne is suddenly raised by heavy rains, a simultaneous effect is produced on the chalk wells in London. This suggests the possibility of connecting a periodical defalcation of water observed in that stream, and the river Lea on Monday, at those seasons when the water is short, with the exhaustion of water under London. The courses of both these streams is somewhat similar with reference to that place, though they flow in opposite directions. There is some evidence in favour of this supposition, which may be established when more information is obtained, which will be best effected by keeping registers of the daily variations of wells in different localities, and determining the height at which the water stands with reference to Trinity high-water mark. Such information, if brought together, would well repay the labour bestowed on its collection.

The author's views were illustrated by a number of sketches and enlarged diagrams of the geological formation of the district, &c.

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Dr. Buckland was desirous to bring the subject of Mr. Clutterbuck's paper before the Institution, because he was impressed with the value of a systematic series of observations upon a matter so intimately connected with engineering as the theory of the causes of the supply of water to springs and

rivers, and the rise of water in Artesian wells.

In his Bridgewater Treatise, pl. 68 and pl. 69, he had illustrated by diagrams the causes of the accumulation of a subterranean reservoir consisting of sheets of water diffused through strata of gravel, sand, and chalk within the basin of London, and of the rise of water in wells and small perforations through the London clay, under the influence of hydrostatic pressure.

Mr. Clutterbuck's observations and experiments confirmed the general opinion, as to the existence of these subterraneous sheets of water in the chalk basin, and indicated a connexion between their distant parts, by the sympathy he had observed between the sudden floods at Watford and certain wells in London, the level of which had been carefully observed, and found to rise a few hours after the occurrence of the floods at Watford. In London, also, he had confirmed observations already made upon deep wells at considerable distances from one another, and found that any large quantity of water taken from one well reduced the level of those adjacent.

It had been questioned whether the communication between wells of this kind took place solely through the medium of large cracks and fissures, or whether the entire masses of the permeable strata, beneath the level of the lowest springs which flowed from them, had all their pores and minutest interstices so entirely filled with water, that any abstraction of this fluid from one well was more or less rapidly replaced by a general flow towards it from every part of the water-logged stratum of sand, or gravel, or stone, in which it was excavated! on the latter hypothesis, during such a flow, the surrounding wells would be affected in the direct ratio of their proximity to that from which large quantities of water were taken.

It had been found at Brentford, that, as the number of Artesian wells increased, the force and quantity of each became diminished; a similar effect followed in the case of adjacent wells in London; the inference he would draw, therefore, was, that a very extensive supply for the metropolis could not be obtained from deep wells of this kind, although a few wells might be supplied abundantly.

The district called the London Basin is made up of a continuous seam of chalk, from 300 to 500 feet in thickness, which on the S.E. of the Colne is covered with beds of sand and gravel, alternating with plastic clay, and over all these, a thick covering of London clay: whilst the country N. and N.W. of the Colne is for the most part composed of naked chalk. Beneath the whole chalk basin lies a sub-stratum of clay or gault which is impermeable by water, and upholds the reservoir in question. The valleys in this chalk are traversed by the rivers Ver, Gade, and Chess, whose chief perennial supply of water is from springs that issue out of the chalk; in one of these valleys Mr. Dickinson had proved by experiments made with Dalton's rain-gauge (which, being buried 3 feet beneath the surface, received only such water as descended more than that depth) that during about two-thirds of the year the rain which fell rarely sank 3 feet into the earth; but in November, December, January, and February it passed down into the subjacent chalk, in proportions which accorded so constantly with the greater or less amount of rain falling in these four wet months, that he had been accustomed to regulate the amount of orders undertaken to be executed in his paper-mills during the following spring and summer, by the indications on this rain-gauge, of the quantity of water that descended more than 3 feet in the preceding winter.

The Colne is often flooded by the effect of sudden rain which is retained upon the surface of the London clay; but that portion of its water which is derived from perennial springs is supplied from the overflowings of the natural reservoirs, or substerranean sheets of water which fill the interstices of the chalk, and also of the sand and gravel beds of the plastic clay formation. The surface of this reservoir is marked by the outbreak of a succession of springs, at levels gradually rising as they are nearer to the upper regions of the chalk; and as the entire supply of this subterranean stock of water is derived from rain that falls on the surface of permeable strata within the London basin, the abstraction of water from any part of this reservoir would, Dr. Buckland conceived, diminish the quantity remaining to be discharged by springs into the rivers in the vicinity of such abstraction, by the total amount of water so transferred to any other than its natural channels.

It was asserted that the surface of the water in this subterranean reservoir did not maintain a horizontal level, but that it rose nearly 300 feet in fourteen miles, between the town of Watford and the highest spring that issued from the neighbouring chalk hills. The molecular attraction of the particles of chalk through which this sheet of water is diffused, and the obstruction presented by friction to its descent through the numerous pores and minute crevices by which it has to pass in adjusting the line of its upper surface, might account for this deviation from the level line which fluids assume, if left to act freely in open spaces, or in large and

continuous conduits; Mr. Clutterbuck's repeated observations upon wells along the line in question must be considered to have proved the existence of this inclined level. His observations were also very important, as to the floods at Watford raising in a few hours the level of the water in deep wells in London, and as to the effect of a steam-engine erected to pump water from a large experimental well near Watford, in lowering the water in smaller wells in that town and the country adjacent to it.

Mr. Dickinson had made very accurate observations upon the absorption of water by the chalk, and was convinced of its being always in a wet state almost amounting to saturation; but few crevices and fissures exist in the chalk of the district under notice; the rain therefore occupies a considerable time in overcoming the molecular attraction of the particles through which it passes. Wherever fissures exist at a certain depth below the chalk, they become channels which collect and facilitate the flow of water to maintain the springs; the accumulations of the winter rain sink slowly down in summer, and by a series of vents or springs furnish a supply for the rivers which run in the deepest valleys of the chalk district; a long cessation of rain lowers the level of the water in the rivers, at an interval of some months after the drought, and any extraordinary demand by pumping from the wells in the chalk, would lower the water in the wells around, even at a considerable distance.

From experiments with the rain-gauge buried 3 feet below the surface, he found that but little rain penetrated to that depth until the months of November, December, January, and February—the total quantity per annum was shown to vary between 17 inches and 6 inches, which latter amount sufficed to fill the principal springs. He was induced to believe that if a large supply of water was drawn from the chalk it would eventually have a prejudicial effect in diminishing the water in the rivers of the district.

Mr. Clutterbuck said that the sphere of his observations extended over a line of wells 20 miles in length, and in the whole of them there was the most perfect accordance between the alterations of level of the water and the indications of the rain-gauge, allowing the time necessary for the rain to sink into the chalk,—as also there was between the fall and replenishment of the wells at Watford and those in London, whence large quantities of water were obtained by pumping;—he could always tell by measuring the height of water in one well of the series, what would be that of any other well along the line: he therefore was satisfied of the accuracy of the observations in his paper.

Mr. Dickinson observed, that he could not satisfactorily account for the greater amount of variation in the wells at the higher part of the district, when compared with those of the lower part—the alternations of the former amounting frequently to 30 feet, while those of the latter were only 10 feet in the same time.

Dr. Buckland believed this fact to arise from the hydrostatic pressure being less interfered with by friction and capillary attraction, in the lower part of the district, than in the upper part.

Mr. Clutterbuck accounted for the alternations of level in the sand springs, being greater than in the chalk springs, by the relative degrees of opposition the water met with, from the friction in passing through the two kinds of strata.

A member observed that the brewers of London could be supplied by the water companies at a cheaper rate than by pumping, but as a large quantity was used for refrigerating the wort, it was important to have the water at a low temperature, they therefore were obliged to pump it up at a great expense. The quantity raised at Messrs. Reid's well was about seven thousand seven hundred barrels of thirty-six gallons each per day, which was calculated to be a sufficient supply for five thousand families—there was already a decided diminution manifested in the supply from the sand springs, and an extension of these effects might be anticipated from the sinking of any large number of wells into the chalk.

Dr. Buckland ascribed the difference of the supply of water in sand springs, and in those originating in chalk, to the relative extent of surface of the sandy and cretaceous strata in Hertfordshire, by which alone they receive their respective supplies of rain-water, the amount of sandy surface being to that of naked chalk about as one to twelve.

The rain filters more rapidly through the sand, than through the chalk. In beds of hard and compact chalk at great depths, the water sometimes finds no passage except through occasional fissures, but where the chalk is soft, loose and fragmentary, it percolates rapidly.

In the deep well now sinking near Southampton, through London and plastic clay into hard and solid chalk, it would probably be necessary to continue the boring or excavation down into some loose and more permeable stratum below the chalk, before any very large supply of water would be obtained.

Mr. Palmer directed the attention of the

meeting to the account of the wells in the London Basin, given in Conybeare and Phillips's Geology, (book 1, chap. iv. sect. 11.) It is there stated, that at Tottenham, which is about 70 feet above high-water mark, after boring through 123 feet of clay, and 2 feet of calcareous sandstone rock, the water rose to within a short distance of the surface in a few hours. At Epping, where the summit of the well is 340 feet above high-water mark, the extreme depth of the bore was 420 feet, but it was abandoned because no water was found; at the end of five months the water rose to within 26 feet of the surface, and it has so continued, at 314 feet above high-water mark.

These recorded facts induced him to receive with much caution the statements in Mr. Clutterbuck's paper, especially since he doubted the ready flow of water through the chalk by which the sympathy between the various wells was demonstrated: he had found that chalk might be used as a good puddle for holding water, and therefore as it was certainly more compact when *in situ* than when it had been worked, unless the water flowed along the faults and the beds of flint, he could not understand how it passed so rapidly as had been stated. The chalk no doubt contained some water, but if it was saturated why did not the water in all the wells assume one uniform level instead of heights varying between 20 feet and 314 feet above high-water mark?

## NOTES AND NOTICES.

*Castor Oil Candles*—Are manufactured in Philadelphia, and said by the American papers to be equal to wax, but not so cheap.

*The Boccius Light.*—A new light opposite Northumberland House, in the Strand (called the Boccius light, after the name of its inventor), was exhibited for the first time on Wednesday evening, and fully answered the expectations which had been by the scientific and practical gentlemen viously had opportunities of inspecting its qualities. It is supported upon six pillars of wood, joined at the top in the shape of a Bourbon crown, and irradiates the entire space between the Post-office and Cockspur-street, the Strand beyond Craven-street, and as far as St. Martin's Church on the north. Nelson's Pillar, with its scaffolding, in Trafalgar-square, appeared as if standing out in broad moonlight, and the gaslights surrounding the statue at Charing-cross were extinguished, as useless, except on the shadow side towards Whitehall. The establishing of this brilliant lamp on a site where the throng of foot-passengers and carriages is so dense and incessant from the intersection of four such great, streets will be of considerable advantage on dark winter nights, particularly to persons having business at the Post-office, as the smallest print or writing can there be distinctly read with ease. The light has a most imposing effect; it is very large, and though peculiarly white and soft, and free from all quivering and unpleasant effect on the eye from its intensity, it is so exceedingly powerful that it is impossible to look at it even for a second of time. It is understood that Mr. Boccius's invention is equally applicable to burners of the smallest as well as of the largest size; and that this increased brilliancy of light is obtained with a great economy of gas, but at what expense has not, we believe, been stated. For the purpose of public illumination the effulgence of this lamp must be acknowledged greatly to excel all others yet produced.—*Observer.* [The specification of this most extravagantly-lauded invention will be found in our 904th Number, and by referring to that, the reader will most probably be a good deal puzzled to discern the why and wherefore it should be so much better (as alleged) than others. The gas is supplied from a number of concentric rings, perforated with a vast number of small holes on their upper surfaces, but this is precisely the plan adopted by Mr. Gurney in what he calls the Bude Light. Instead, however, of one chimney, as usual, the Boccius Light has two chimneys, one within the other; and so far, certainly, there is novelty: but novelty of a strange sort,—whereas it has been generally considered advisable that the chimney of a lamp should cast as little shadow as possible, the second chimney of the Boccius lamp is made of solid metal, and casts a darker and deeper shadow than any we ever saw. Our present impression of this new wonder of the day is—that what is good in it is not new, and what is new is not good.—Ed. M. M.]

*Steam Voyage through France to the Mediterranean.*—The following extract from a Leghorn letter or the 10th August appears in the *Times*:—"Yesterday three steamers arrived here. They came from England, and made their voyage through France, for they first ascended the Seine, and then passed by the way of the canals into the Mediterranean. This is the first voyage of the kind that ever was made. These steamers are small iron boats made for the Papal Government, and destined as tugs for the Tiber, to tow merchant ships up the river. They sailed again yesterday evening for their destination."

*Meteoric Stone.*—Dr. J. Magill (of Cookstown) has communicated an account of a phenomenon that occurred in Harrowgate on the 5th inst., from which it appears that at five o'clock, p.m., during a heavy squall, accompanied by vivid flashes of lightning, from the south-east, some persons at work in draining the common in High Harrowgate, heard a hissing sound in the air, and almost at the same moment observed a dark object falling at a short distance from them, which, on examination, proved to be a large aerolite, or meteoric stone, similar to those which fell a few years since near Cardiff. On examining it the following morning, in company with Messrs. Thompson, J. M'Caw, and J. Montgomery, they found it had the same appearance as the basalt of the Giant's Causeway, with this extraordinary difference, that it is interspersed with small particles of silver or flint, and what geologists term *album Grecum*, or white Greek stone. The men who first saw it state that "it was warm to the touch," but the Doctor doubts that such was the case. It weighs about half a ton.—*Mining Journal.*



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## BUNNETT'S PATENT IMPROVEMENTS FOR INCREASING THE SAFETY OF RAILWAY TRAVELLING.

Fig. 1.

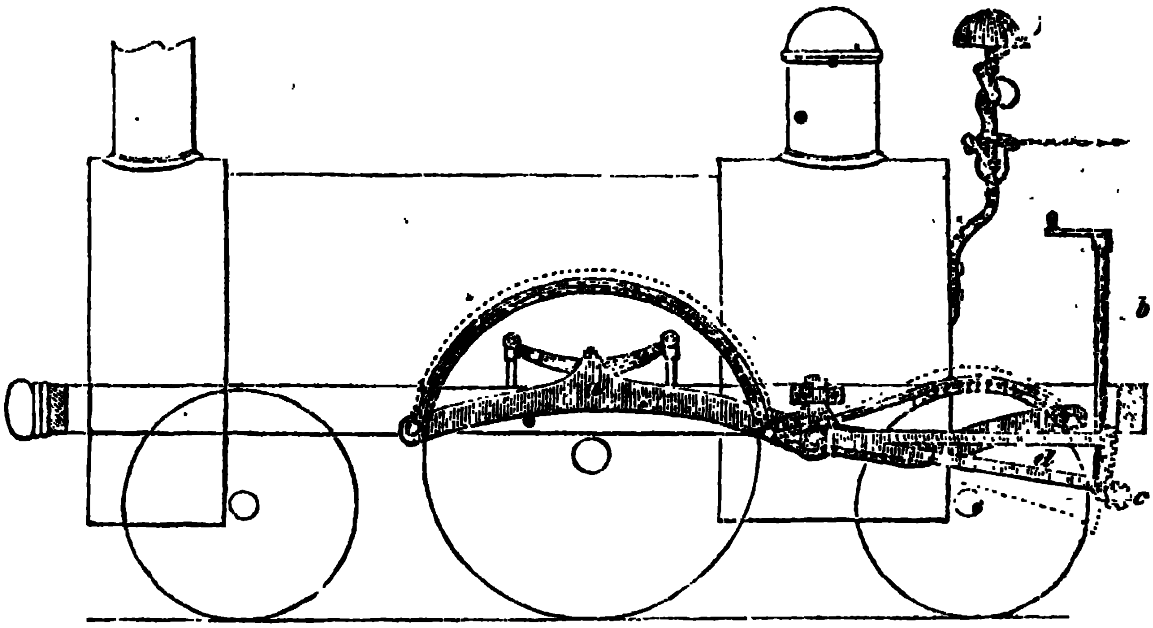


Fig. 2.

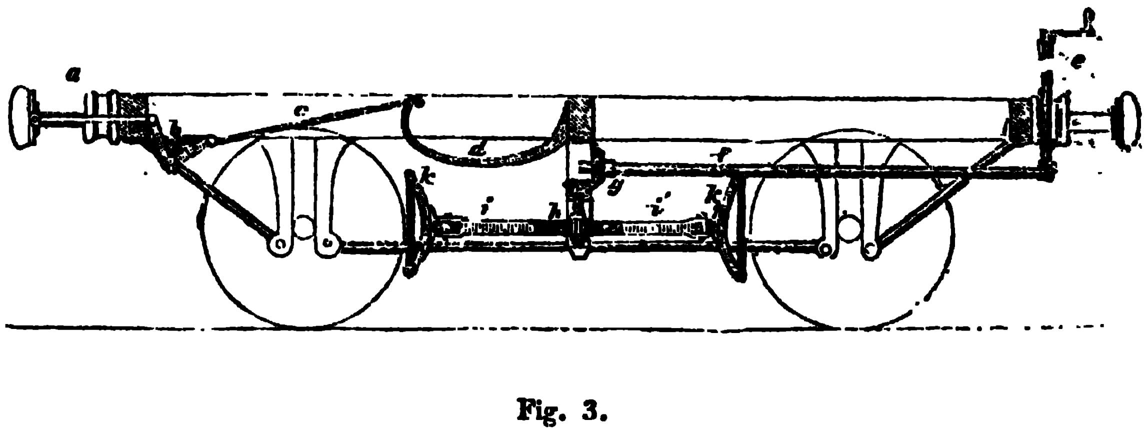
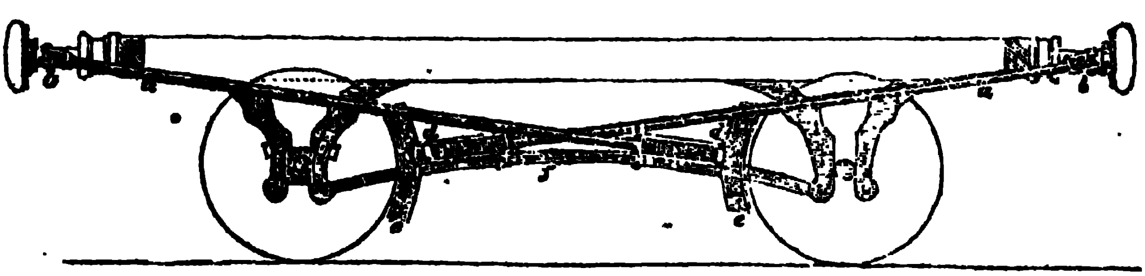


Fig. 3.



## BUNNETT'S PATENT IMPROVEMENTS FOR INCREASING THE SAFETY OF RAILWAY TRAVELLING.

Sir,—No sooner does a serious accident occur on any of the lines of railway, which now intersect this country in all directions, than a general outcry is raised against the railway system, and mechanical expedients without number are suggested for preventing similar accidents in future. During the excitement which at such times prevails, it unfortunately happens that the parties more immediately interested in the safety of railway transit, have neither time nor inclination to investigate the comparative merits of the numerous crude suggestions with which they are then inundated.

In calmer moments, however, I imagine that railway companies must feel themselves bound to consider with some degree of attention *all* the remedies that may be proposed for diminishing the dangers of railway travelling; and in order that these parties may have no excuse for remaining ignorant of any of the plans so put forward, it is desirable that these plans should have due publicity given to them by means of our scientific periodicals. The *Mechanics' Magazine* has strikingly lent itself to this national object, and I now beg permission to make use of its pages for the purpose of recording several important methods of increasing the safety of railway travelling which formed the subject of a patent granted to Mr. Joseph Bunnett, of Deptford, Civil Engineer, in the early part of 1841.

These plans were briefly noticed in your pages (No. 939, vol. xxxv. p. 110,) at the time the specification was enrolled, but they will now be rendered better understood by means of the accompanying engravings;* of which fig. 1 shows a powerful break for the use of locomotive engines. *a* is a strong iron carriage for the breaks, laying flat against the side framings of the engine, bearing on and attached to the centre springs, and supported by, and also sliding freely through a staple bolted to the side frame, to allow for the play of the springs.

*b* is a vertical shaft, on the lower end of which there is a worm taking into a worm-wheel keyed on a horizontal shaft which passes across beneath the foot-plate; on this horizontal shaft are two pinions, *c* working into two racked sectors or levers *d*, placed one on each side of the engine opposite to the wheels. On turning the handle of the shaft *b*, and bringing the levers into the position shown, the breaks are brought down simultaneously on to the driving and trailing wheels of the engine. By turning the handle in the reverse direction, the breaks are removed from off the wheels and raised into the position shown by the dotted lines.

The break bands are of steel, to the underside of which may be bolted two boxes, or segments fitted with wood or other elastic substances, if thought desirable.

Attached to the fire-box of the engine is a bell *f*, on which, by means of a suitable arrangement of spring levers, one or more blows can be instantaneously struck by the guard on any carriage in the train, and the engine driver's attention called to any signal it may be necessary to make to him. The communication is continued throughout the train by means of horizontal rods lying along the top sides of the carriages connected together by short chains.

Fig. 2 is a side elevation of a railway-carriage frame fitted at one end with a *self-acting* break, which it is proposed should be applied to all the wheels. *a* is a connecting-rod attached to the buffers; *b* is a bell crank, the axis of which is attached to the side frame of the carriage; *c* is a strong band or belt of leather, plaited hemp, wire rope, or other suitable material, to the underside of which (if necessary) plates of metal may be fastened; *d* is a curved spring, to one end of which, and to the bell-crank *b*, the band *c* is attached. Upon the buffer being driven in, the motion of the bell-crank *b* brings the band *c* down upon the periphery of the wheel with a force proportionate to the strength of the spring *d*, and the momentum of the moving mass. On the buffers resuming their original position, the band *c* is raised from off the wheels.

The other end of figure 2 likewise shows the construction of a *manual* break. *e* is a vertical shaft and worm working into a worm-wheel on the end of a hori-

* Well finished explanatory models, one-eighth of full size, showing each matter in detail, may be inspected at Messrs. Bunnett and Corpe's Office, 26, Lombard-street, London.

zontal shaft *f*, which gives motion to a pair of bevel wheels *g*, one of which is attached to a short vertical shaft carrying a pinion *h*; this pinion takes into two racks *i i*, kept in gear by friction rollers placed at the back; the ends of the racks are prolonged and attached to the centres of two bars lying across the carriage and carrying at each end a spring bow (*k k*) fitted, either with elastic bands of some suitable fabric, or boxes filled with wooden segments, &c.

Fig. 3 shows another form of *self-acting* break; *a a* are strong iron rods attached to the centres of two cross-bars *b b*, the ends of which are attached to the back of the buffer-heads; the other ends of the rods *a a*, are forked, and embrace springs *c c*; the ends of these springs impinge against bars *d d*, laying across the carriage, the ends of which are fitted with boxes containing segments of wood or other suitable material, or with bows similar to *k k* in fig. 2. *f* is a curved stay in the plane of action towards the centres of the wheels, on which are formed guides for the ends of the bars *d d* to move upon; the springs *c c*, and the bars *d d*, are shown in section. The rods *a a*, are capable of adjustment lengthways, so as to bring the breaks to bear upon the wheels when the buffers shall be forced in to any determined point. The action of these breaks on the wheels is simultaneous, and the force is equalized and regulated by the strength of the springs *c c*.

The value and importance (in theory) of an efficient system of breaks for railway carriages has been constantly asserted in your pages, and it would, perhaps, be difficult to find a higher *practical* testimony to their immense advantages—especially those of a self-*acting* description—than that given by Mr. George Stephenson, before a Select Committee of the House of Commons, in the following words:—

"*Question* 1319. By Mr. Labouchere.—You have, of course, devoted much attention to the means of preventing accidents upon railways?

"*Answer*.—I have.

"*Question* 1320.—You have paid much attention to the subject of breaks?

"*Answer*.—I have.

"*Question* 1321.—Do you consider them an important element of safety in railway travelling?

"*Answer*.—Certainly; the most important of anything that can be contrived for the safety of railway travelling. I believe, that if self-acting breaks were put upon every carriage, scarcely any accident could take place.

"*Question* 1322.—What do you mean by self-acting breaks?

"*Answer*.—Whenever the power is taken off the engine by the engine-driver, it immediately ceases to proceed so fast; all the carriages immediately run towards the engine, with the impetus put into them before the engine was retarded. Every carriage, as it approaches the next carriage, shall apply the breaks itself. Every carriage is brought into the state of a sledge; the rolling motion of the wheels ceases; and supposing that an engine was running on with 12 or 14 coaches, and that every coach had a breaksman (that is, 12 coaches and 12 breaksmen), and the whole of them upon the look-out to see if anything went wrong in the engine, to apply the breaks immediately, I conceive that the *self-acting principle* is *fifty times better*."

It will be seen that the action which Mr. Stephenson considered so desirable, is precisely that which distinguishes Mr. Bunnett's invention.

Among other recommendations of Mr. Bunnett's breaks, is the entire absence of concussion on their application; being governed by the buffer springs, and formed of an elastic material, they entirely obviate the disagreeable jar, and harsh grating noise so frequently, and so justly complained of. Besides this, more or less force is in every case applied exactly as the exigencies of the case may require.

Should the strength of the buffer-springs be at any time insufficient to admit of backing a train, a very ready mode can be provided for preventing the action of the breaks upon the wheels.

I remain, Sir, yours respectfully,

Wm. Baddeley.

29, Alfred-street, Islington,
August 31, 1842.

## MR. HALL'S LOCOMOTIVE SMOKE-BURNER.

Sir,—I had intended, this week, going into the several points referred to in my letter, inserted in your Magazine of the 3rd instant, with reference to Mr. Hall's pretensions, and his mode of admitting air to the furnaces of locomotive engines; but finding Mr. Hall disputes Mr. Kearsley's statement on this subject, I will not

interfere, until the success or failure of Mr. Hall's plan be decided. As a mere matter of caution, on my part, this is manifestly called for, as I do not choose to point out either the errors he has committed in his mode of introducing the air, or suggest how he could remedy such error.

For the present, then, I can only repeat that, when the dispute respecting Mr. Kearsley's report is decided, not by Mr. Hall's opinion, but by that of more impartial judges, I am prepared to prove my three propositions — 1. That Mr. Hall's mode of introducing air is an infringement of my patent; 2. That he has carried it into practice so injudiciously, as to insure its failure; and 3. That it is *cold*, and not *hot* air which he introduces. These points being to be considered on purely scientific grounds, there can be no room for any *personal* matter or angry comment. But it is strange, in a matter based so exclusively on chemical considerations, as the peculiar modes of bringing the oxygen of the air into chemical union with the combustible gases evolved in a furnace, that those who dispute the correctness of my practice and details, will not discuss the question on chemical grounds, but fly away to the irrelevant points of the old practice, the acknowledged proportions among the parts of a furnace, and their areas and sections, &c. &c.; and, what is even still more irrelevant, dispute my right to give an opinion, as not being a professed engineer, or as presuming to know better than "operative engineers," or so-called "PRACTICAL" men.

The real question at issue is, whether my facts or assertions be true or not. The merits of the question, as to the principles I have urged, are for the consideration of the chemical professor, and not for those who reject chemical considerations.

With your permission, Sir, I will, from time to time, continue to put before your readers, not merely the chemical results of my practice, but the details of the practice itself.

I am, Sir, yours, &c.,

C. W. WILLIAMS.

Liverpool, September 8.

## LIFE ASSURANCE.

Sir,—The question I proposed (No. 989) in your highly useful journal, has been the means of producing some of the best written and truly important articles on Life Assurance that have ever appeared in your Magazine, or perhaps in any other periodical. My best thanks are due to Mr. George Scott for the multifarious calculations he has made on this highly important subject. The question has also been ably discussed by G. and Kinclaven. I am sure if any of these gentlemen had seen the prospectus of the West Middlesex Independent Life Assurance Society, they would soon have blown it up in your Magazine without the assistance of the renowned Sir Peter, and saved the deluded multitude many thousand pounds.

If it would not put your scientific correspondents to too much trouble, I would esteem it a great favour if they would give their opinion upon the following little Table which I have copied from the prospectus of an Assurance Company. So far as I am enabled to judge, the annual premiums are higher than safety requires.

Table of Annual Premiums for securing £100 to a child on attaining the age of 21.

| Age not exceeding years. | Annual Premiums. | | |
|---|---|---|---|
| | £ | s. | d. |
| 1 | 3 | 5 | 6 |
| 2 | 3 | 10 | 6 |
| 3 | 3 | 17 | 6 |
| 4 | 4 | 4 | 0 |
| 5 | 4 | 11 | 3 |
| 6 | 4 | 19 | 9 |
| 7 | 5 | 9 | 10 |
| 8 | 6 | 1 | 2 |
| 9 | 6 | 14 | 8 |
| 10 | 7 | 10 | 6 |

I am, Sir, your obedient servant,

IVER MAC IVER.

September 13, 1842.

## PLAN FOR THE APPLICATION OF THE STEAM POWER OF H. M STEAMERS TO THE PROJECTION OF SHOT, AS WELL AS TO PROPELLING PURPOSES.

Sir,—Whilst I cannot but rejoice in the exertions of those well-intentioned individuals who are seeking to subdue and extinguish the spirit of war and the rage for conquest, and shall ever feel gratified at their success, yet still I have to lament that there appears every probability and prospect that the honour—nay, the existence of our empire will, at no great distance of time, require again the unfurling of the blood-stained banner of Mars

So long as France appears animated, as at present, with the restless and unsubdued ambition for military renown, combined with jealousy of our maritime superiority; whilst Russia continues to grow up, as it were, to the manhood of a vast military empire,* and whilst our descendants and neighbours across the Atlantic evince so pertinacious and crowing a disposition, even so long, Sir, as these facts and evidences exist, and appear to increase, will it be necessary to send forth our wooden, or rather iron walls, to maintain peace and good order

Impelled, Mr Editor, therefore, by the force of these powerful arguments and unwelcome facts, I have great pleasure in submitting to your notice and approval a plan of propelling bullets and other projectiles by a mere breath of air

I dare say, Sir, that you well remember the "no small stir and excitement produced when Mr Perkins first brought out his steam gun, which, indeed, continues to be a very popular exhibition, no doubt, also, you are acquainted how that invention has never been turned to any practical account on a large scale Now, Sir, the object of my addressing you is, to give a "local habitation and a name" to a scheme bearing some resemblance to that of Mr Perkins, which has been revolving in my mind, and not being able to discover any great objection to its *practical* application, I wish to record it in the most *practical* work of the age

The steam-engines on board steam-packets have been constructed lately of immense size and power, two and three hundred horse-power engines have of late become general, and some there are even of the power of four, five, and six hundred horses, indeed, there scarcely appears any limit to the size and power which may be given to these machines What I propose is, that this enormous power, which in those vessels is always available, should be applied to the purpose of projecting balls, bullets, shells, &c, of what size, shape, or nature soever may be thought most desirable The medium by which this power is to be transmitted from the engine to the projectile is atmospheric air, applied in a manner somewhat resembling the common air gun

For the compression of the air I would have a series of air-pumps, through which the air should be passed from one to another, diminishing the diameter or bore of the pumps as the air becomes more compressed, and increasing the strength and thickness of the metal of the pumps in the same proportion, and either discharging the air from the gun as fast as it is supplied or compressing it into a reservoir to be used when required, which reservoir I propose should be made of wrought iron tubes, which, as is well known, can be made to sustain an immense pressure

For the discharge of the balls or bullets, I would either employ a similar apparatus to that of Mr Perkins, or a peculiar construction which I have devised, by which a regular and continuous succession of balls can be supplied into the gun

As only one or two guns would be necessary for discharging an enormous quantity of balls, the guns required could be made of a length greater than usual, to obtain the full effect from the air expended, and at the same time secure greater accuracy of aim

There are various methods by which the paddles can be disconnected from the engine, which would answer equally well to connect the engine with the pumps for the compression of the air, so that the air-pumps and the paddle-wheels could be worked either together or separately, as required

The whole apparatus is of simple construction, and the additional weight is but trifling, thus, the mighty power which drags along at one moment, the

* See Alison's History of Europe

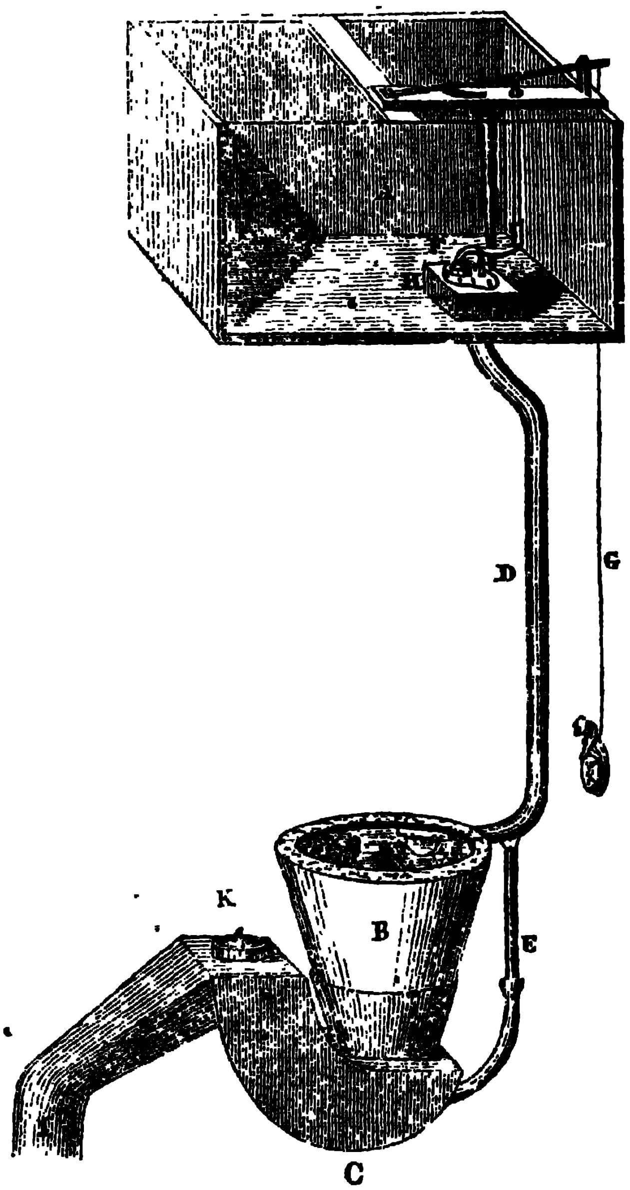
bulky "fire-spirit" of the deep, could, in the next, be made to send a storm of bullets rattling along the watery main!

From experiments which have been made on the explosive force of gunpowder, and from comparison with the effect produced by the compression of air, I submit that the above will be the most humane, expeditious, safe, and economical method of keeping our refractory neighbours in peace and quietness; and, as in duty bound, I beg to propose the plan "pro bono publico."

I remain, Sir,
Your obedient servant,
C. W.

## SMITH'S PATENT WATER-CLOSET.

[Specification Enrolled, August 27, 1842.]




The improvement which forms the subject of this patent is one of remarkable simplicity, but like most simple inventions, one of the greatest practical value. We shall first give Mr. Smith,* the patentee's description of his invention, and then state the results of some extensive trials which have been already made of it in his own neighbourhood.

The prefixed engraving represents the fittings up of a water-closet constructed ac-

* Plumber, Northampton.

cording to Mr. Smith's improvements in their complete state. A is the cistern; B the basin; C a trap connected with the bottom of the basin; D a principal service pipe which conveys the water from the cistern to the basin, E, a secondary service pipe which proceeds from the large service pipe D (at the point where it turns off towards the basin,) to the back of the trap C, F, a spring valve, by the raising or lowering of which, by means of the wire, or cord G, the supply of water from the cistern is let on or shut off; H, the box of the service pipe D, and I the discharge pipe. When the valve F is raised, the water rushes at (nearly) one and the same time through the principal and secondary service pipes D and E into the basin and trap, so that the contents of the basin are no sooner carried down into the trap by the main stream of water, than they are driven forward by the secondary stream from the back of the trap into the discharge pipe I, and any detention or deposit is thus effectually prevented. The adoption of the secondary service pipe rendering any considerable length of fall unnecessary, enables the inventor to give to the trap the short curved form represented in the drawing, which is attended with this further advantage, that the basin and trap may be placed on the floor of the closet, or other apartment, where they are fixed (the distance from the top of the basin to the bottom of the trap being only about 18 inches,) instead of its being requisite to cut away the floor, as is frequently the case with water-closets on the common construction. Should the trap at any time become accidentally stopped up, there is a small door K, at the top, through which access may be obtained to clear away the obstruction. The principal service pipe the inventor makes of an inch and a half strong lead pipe, and the secondary pipe of the same material, but only half the size. The service box should be made of lead of 9 or 10lbs. to the foot, and not larger than to afford just sufficient room for the valve to work in. In most cases the service box need have no bottom, but may be simply placed on the mouth of the service pipe, the latter being soldered into the bottom of the cistern. But where want of room makes it desirable to have a small cistern, it will be proper to make the service box with a bottom, as usual, and that very strong. When the basin and trap are fixed, they should be well packed all round with saw-dust, or some other non-conducting material, to exclude the effects of frost, though, unless when accidentally obstructed, there can seldom be any lodgment of water in either.

Water closets on this plan have been introduced into a number of public and private establishments in the town and county of Northampton, and appear from certificates which are before us, to have given every where the greatest satisfaction. One of these certificates we shall be excused for quoting at length, when we mention, that it bears at foot the name of so deservedly high an authority in all matters of practical improvement, as Earl Spencer.

"Northampton General Lunatic Asylum,
"June 2, 1812.

"The House-Visitors and Medical Superintendent having made repeated and just complaints of the Water Closets of this Institution, and of their inefficiency to meet the various causes of obstruction peculiar to Establishments of this character; the Committee having also further incurred considerable expense in alterations and repairs, without deriving any permanent benefit, they were at length induced to give the Closet, for which Mr. Smith has taken out a patent, a trial in the Retractory Ward of the female division of this Asylum; the closets of that part of the building being most frequently out of order. The result of this experiment has been perfectly satisfactory to the Committee and all the Officers, and an immediate order is made for their general introduction It is with great pleasure that the Committee, after nearly twelve months' experience, bear full testimony to the great value of Mr. Smith's Patent Closet; and in justice to him they would further state, that they believe these Closets, from their construction, to be peculiarly adapted for use in Lunatic Asylums

"SPENCER, Chairman."

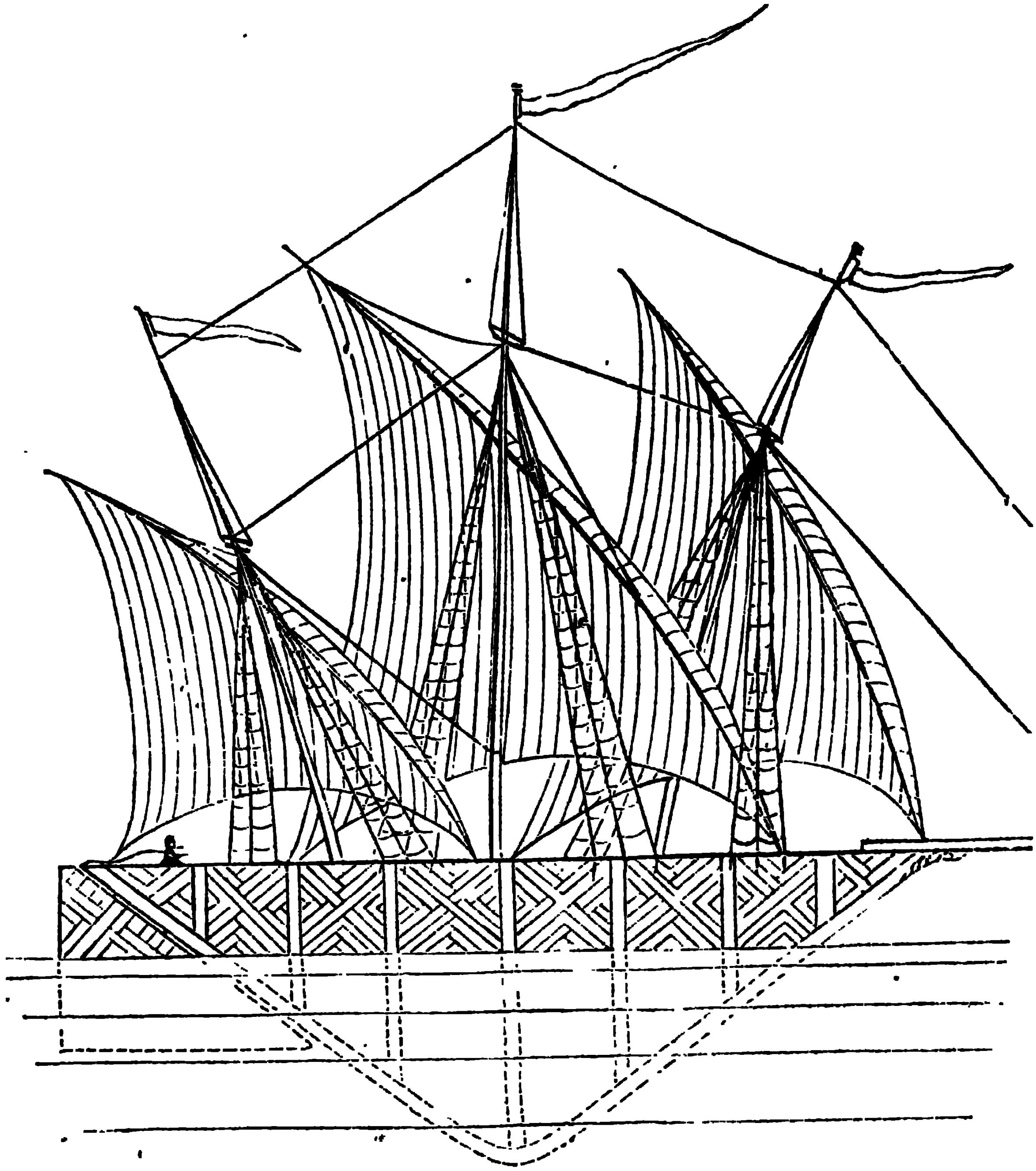
Dr. Prichard, the Physician-Superintendant of the Northampton General Hospital for the Insane, expresses a strong conviction that "the introduction of Mr. Smith's Patent Closets into similar Institutions will remove a pregnant source of anxiety and disquiet to them, and also add materially to the comforts, convenience, and health of the patients."

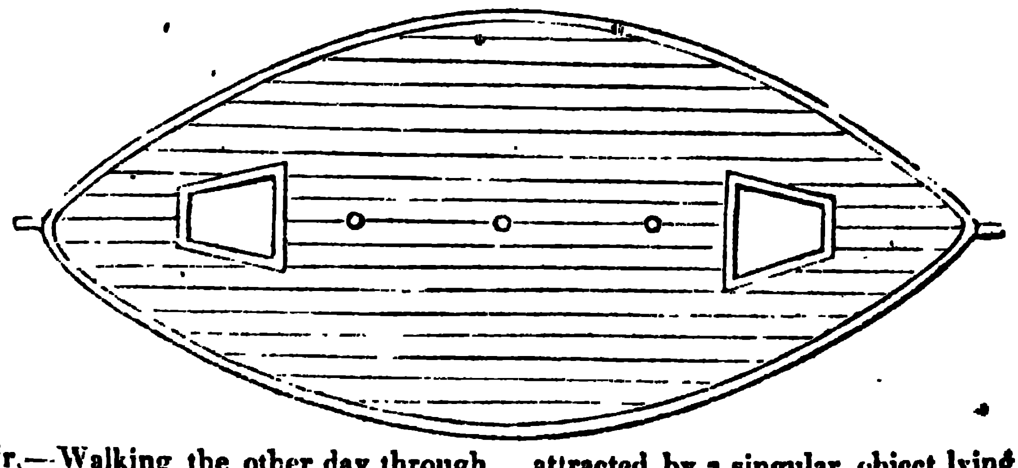
The Governor of the County Gaol and House of Correction, Northampton, considers them "superior to all others which have been fixed upon different principles in the Prison."

There are other certificates, equally favourable, from Mr. Miln, the County Surveyor, and Messrs. Hull, Law, and Elliott, Architects.

The best of all certificates, however, is the manifest utility of the invention itself; it is one of those things which needs only to be seen, to be approved of and adopted.

CHINESE SYSTEM OF SHIP-BUILDING





Sir.—Walking the other day through the West India Docks, my attention was attracted by a singular object lying high and dry on its broadside. I had some

difficulty at first in making out for what object it could be intended. On enquiry and investigation, I discovered it to be the hull of a Chinese vessel, which my informant stated had been recently brought to this country by the *George IV.* transport. I transmit herewith a pen and ink sketch of it, for insertion in your Magazine, should you deem it worthy of a place there. I am the more desirous of drawing your attention to it, as I perceive that a Mr. Dempster lays claim to the invention of a "*new* system of building vessels," which is in every respect similar to that represented in the accompanying sketch. (See No. 985.) I must say that our ancient friends (though now bitter enemies,) and near relatives of the sun, moon, and stars, have a just right to complain of our conduct to them of late. Not content with forcing opium upon them, whether they will have it or no, and battering their towns and forts about their ears, because they won't pay for it, *at our own valuation*, we pirate their ancient inventions, which are probably as old as their own country, and without one word of acknowledgment, give them out to the world as our own! Assuredly they are a most ill-used people, and I trust that you will take up the cudgels in their behalf, and in common justice to them, give them their due share of whatever credit appertains to the invention.

The form of vessel shown in the sketch has probably been in use in China for centuries; no doubt, if they were questioned on the subject, they would tell you it had been in use some 5, or 6,000 years at least. The vessel, as you will perceive by the plan of the hull, is a three masted one, and my informant (a lad who came home in the *George IV,*) stated that the masts raked fore and aft, somewhat in the manner I have shown; but as the masts have been taken out, I cannot vouch for the perfect accuracy of the sketch in this respect. The sails also I have supplied from a form of sail, which is, I believe, in common use in China, and is what we call a "shoulder of mutton sail." The prevailing idea in the construction of this vessel, seems to be the form of the triangle, which I have carried out, by making the rudder (which is wanting in the original,) also of that shape. The idea is one which, I think, is by no means to be despised, for it is obvious, that with such a formed vessel and such sails it would be next to an impossibility to capsize her, from the centre of gravity being placed so low down; to use a common mode of expression, one might carry on in such a vessel until "*all was blue*," without much danger of foundering, if all was tight and well battened down on deck. It is true, you might tear the masts out of her if they were unyielding, but as these, and the sails also, are, I believe, made of bamboo in China, the former would "bend before the breeze" until they almost touched the deck, before they would give way.

We may remark how perfectly such a description of vessel is adapted for encountering the violent and sudden typhoons that are so prevalent in the Chinese seas: a square-rigged vessel, caught in one of these, seldom dares to show a stitch of canvass to it, and her only chance is to scud before it under bare poles; whereas, John Chinaman, in his floating tea-chest, makes all tight on deck, and smokes his pipe with the utmost nonchalance, whilst his bark scuds along at double railroad pace.

With respect to the plan of the hull, the form is one which, I believe, is now generally admitted to be that of a solid of least resistance, viz., the double cone: I am not, however, prepared to say that this form of vessel, viz., tapering to a point at the apex, and that apex the bottom of the vessel, would be the best, practically speaking, although it might theoretically. The great objection to it would be the depth of water such a formed vessel would require, and which would quite unsuit it to certain navigations: but I have no doubt that this form, *slightly modified*, would be found both practically and theoretically the very best that could be adopted for speed and safety.

I am not sufficiently versed in mathematics to investigate the subject further, and I therefore leave the mathematical investigation to some one of your readers who may be better qualified for the task than myself, contenting myself merely with drawing attention to the subject, and to the scientific claims of our Chinese friends.

I beg to subscribe myself, Sir,
Your obedient servant,
ARCHITECTUS.

Stangate, September 2, 1842.

### STEAM PRESSURE OF THE RIVER THAMES STEAMERS.

Sir,—Much has been said upon the danger involved in the use of high-pressure boilers, and various opinions have been expressed concerning the new steamboat *Locomotive*, propelled avowedly on that principle. While others are giving expression to their apprehensions upon the subject, (to not one word of which have I any objection to offer,) I may perhaps be permitted to enlarge the field of their inquiry, and (if I am correctly informed) of censure at the same time, by putting a question or two.

I would ask, then, at what pressure of steam in the boiler are the *Railway*, *Blackwall*, and *Brunswick* worked? The *Satellite?* the Waterman's Company's boats? the *Isle of Thanet?* and last, though not least, the far-famed *Ruby?*

Is this last vessel fitted with "Locomotive" boilers, and worked at a pressure corresponding to their construction and ordinary use?

Your Journal has, (to my own knowledge,) too much real interest in the welfare of the engineering profession to admit of the motives which influence these inquiries being misunderstood. With great confidence in the skill of London engineers, I may, nevertheless, be excused for calling attention to the subject of pressure, that we may not relax in care and attention, and so rival our transatlantic friends in the only point of steam navigation in which they are superior to us, namely, the number of lamentable accidents with which, (in their hands,) it is attended.

VALVE.

London, September 8, 1842.

### IMPURE WATER—FILTRATION.

Sir,—You have recently devoted a considerable portion of your very valuable Periodical to the water qustion. For this, not only men of science, but all to whom health is a consideration, will thank you. The importance of the subject cannot be over-estimated. The supply of London alone has occupied the attention of the ablest and the noblest in the land. The present Premier many years ago expressed most strongly his conviction of the necessity of a great reform in the Water Companies; and princes and peers, orators and statesmen, the *élite* of the legislature, have devoted days and months to enquiries how, and and at what cost, the people of this vast metropolis could be supplied with pure, clear, and wholesome water.

Upon one point all are agreed, viz., that the water at present supplied in London, and many large towns, is at once nauseous and noxious—that it is destructive to health, and often to life—and that, in fact, to use the allegations made to Parliament, it is "charged with the contents of the great common sewers, the drainings from dung-hills and lay-stalls, the refuse from hospitals, slaughter-houses, colour, lead, and soap works, drug mills and manufactories, and with all sorts of decomposed animal and vegetable substances."

Taking these premises to be proved, many of your correspondents suggest remedies; the last of whom, Mr. Baddeley, gravely recommends the more frequent cleansing of cisterns by consumers themselves; and treats with some levity a notice in the Order-book of the House of Commons, that, at the earliest period of next session, an enquiry shall be instituted by a Select Committee, whether the Water Companies are not bound, and ought not to be compelled, to deliver their water in a much purer and healthier state.

Now, with regard to Mr. Baddeley's "remedy," no doubt it is good as far as it goes, abstractedly; but bad and mischievous if allowed to divert public attention from getting rid of the evil at its source. The more frequent cleansing of cisterns would tend to lessen, periodically, the amount of dirt that gets there; innocent people, however, like me, might be apt to think that it would be somewhat wiser, and not quite so troublesome, if such dirt were not permitted to get there at all. But tastes *will* differ.

A venerable lady, of the name of Partington, betook herself, at the time of a flood, to sweep back the waters of the Atlantic with her besom. Good old soul! she has many followers in these days, and some of them have learned her lessons—not *badly*.

But, badinage apart, does Mr. Baddeley seriously think that the people of large towns will quietly take to cleaning their cisterns every week, or oftener, to get rid of the dirt that is *deposited*—they cannot get rid of that which is floating—when they know that there is an ascertained and proved remedy, which would prevent any dirt from entering

into their cisterns at all? A remedy so simple, and so certain—so comprehensive, and yet so economical—that much longer to refrain from adopting, it will bring down the condemnation of Parliament and the public, upon the heads of those whose monopolizing selfishness refuses to secure so great a boon for their customers?

That remedy is, *Mr. Stuckey's System of Filtration*, which, by one machine alone, 5 feet square, as stated by Lord Brougham in the House of Peers, filters no less than two millions five hundred thousand gallons every 24 hours, both effectually and beautifully.

Now, touching the non-application of that remedy, mark what Mr. Stuckey modestly states, in his petition to the House of Commons:—"That so satisfied were the representatives of the Water Companies, then present, with the capability, utility, and superiority of your petitioner's system of filtration, that your petitioner has been informed by some of their chief officers, and believes it to be true, that they would immediately adopt your petitioner's system of filtration, and give the inhabitants of London the vast advantage of pure, limpid and sparkling water, provided any scheme could be devised to repay them the expense, comparatively small as it would be, of adopting and carrying on the processes of filtration by your petitioner's invention; but, as they were afraid that they would not be permitted to increase their rates, in the present temper of the public mind, and of the two Houses of Legislature, they must defer doing so, until your petitioner could point out some means of creating a remunerating fund to meet the cost."

No wonder, after such an allegation as this, a notice was given in the House of Commons of future enquiry into the conduct of the Water Companies in this matter—no wonder that gentlemen wishing to offer their services, "for a consideration," to such wealthy corporations, at the hour of their trial, are beginning to show themselves; but it will not do—pledges have been given by Members of both Houses of Parliament—not so much to enquire into the foul and filthy state of the water, for that is already so demonstrated, that the unblushing effrontery of monopoly cannot now stammer out another syllable of denial; but, to come at once to the question, Have the Water Companies kept good faith with the public and with Parliament, by "effectually filtering" their supply, as they promised and pledged themselves to do?

Your correspondent, Mr. Baddeley, seems to sneer at the notice for next session, which Mr. Hawkes has given. Does your correspondent know, whether Mr. Hawkes gave that notice on his own part, or on the part of a highly influential member of the Government, who will probably preside over the committee? Does Mr. Baddeley know, that a Noble Lord in the House of Peers, the first in one respect in the land, has promised a similar enquiry in the Lords? I am sure, if your correspondent, had been aware of these matters, and of others, which I only know in confidence, he would have paused before treating with levity an enquiry likely to be productive of such valuable results, as that of which notice has been given.

For every life lost by impure water—for all the diseases generated thereby—for most of the cases of English cholera, now so prevalent, those who, from selfish considerations, refuse to "effectually filter" the water they supply when they have it in their power, are answerable, if not to man, to God! A very small cost by companies realizing very large profits, would confer on their customers an inestimable blessing;—is it too late to hope that such may soon be the case, so as to prevent the necessity of Parliamentary interference?

I have the honour to be, Sir, your most obedient servant, B.

Grafton-street, September 14, 1842.

## SMOKING ON RAILWAYS.

Sir,—I prefer addressing you on the following subject, in preference to the Editor of any other publication who might feel interest enough in the matter to notice it, because, being known to you, you will have confidence in the correctness and truth of what I relate.

A short time since, a foreigner travelling in the coupée of a second class carriage on the Brighton Railway, smoked a cigar. The guard warned him that the practice was not allowed. Nevertheless, the gentleman, most likely used to the way such things are managed on the Birmingham line, when the guard retired from performing his duty, continued to smoke, and finished his cigar. At the next station, he was met by a demand for his ticket, ordered out of the coupée, and subjected to the following treatment. The guard addressing one of the officers on the

platform, warned him that, "that person was not to be allowed to proceed to London by any train that night," and there the gentleman was left! The guard on being remonstrated with, very civilly replied he could not help it—such were his orders—he should be discharged, or fined, if he did not execute them—and there was a director in the next carriage. Now, Sir, I ask, whether such a mode of punishment ought to be tolerated in a free country? If such is the rule of the Brighton line, it ought to be distinctly notified to every passenger. Complaint at its enforcement could not then be made, although we might exclaim against its severity. Surely, to have taken the man's ticket away, and forced him, before he could proceed to London to buy another would have been punishment enough. Nine shillings and sixpence for smoking a cigar is paying dearly for one's whistle, but arbitrarily to debar him from proceeding by the same train was, to my thinking, most unjust and cruel. The individual in question may have been put, to not only great inconvenience, but possibly very heavy expense, by being detained from the completion of his journey so many hours. What makes the present case worse is, the circumstance of the victim being a foreigner.

The directors of the Brighton Railway as a body, are not over popular; surely there ought to be wit enough among so many, to devise some scheme for the enforcement of a regulation proper enough in itself, and not quite so obviously tyrannical.

Yours faithfully,

AN OLD CORRESPONDENT.

[The reasonable complaint of our "Old" and much esteemed correspondent, brings to mind the remedy once facetiously proposed by another of our contributors, for the nuisance—for such it undoubtedly is—the commission of which involved his foreign friend in such unpleasant consequences. It was to this purpose—that smoking on railways should not be absolutely prohibited (for the liberty of the subject's sake!) but that the smokers should be obliged, by Act of Parliament, as the engines are—*to consume their own smoke*. ED. M. M.]

## THE CRANK QUESTION.

Sir,—"A mechanical disadvantage"—a deficiency of effect—but not a loss of power in the crank, your correspondent, "R. W. T.," contends, is what my experiments prove, and what, he says, "*nobody will deny does take place in some parts of the crank's course.*" I am perfectly satisfied with his definition. The words "loss of power" shall not be made use of by me again—it shall be a "mechanical disadvantage." I suspect, however, the change will not much benefit your correspondent.

He wishes to quarrel with me because I exemplified practically my meaning of the term "loss of power," but did not define it. What nice, but unnecessary distinctions! I wish he had exemplified his meaning, as I requested of him, and I would make him a present of what he intended for definition. I am glad, however, that I have pinned your correspondent down to a practical point, by the definition he has given, as above, of the crank's action.

Your correspondent says, at page 77 in the present volume, that if I should at any time prove, ever so clearly, any practical loss to exist in any engine or machine of my construction, I must look somewhere else than to the crank for the cause. Now, I would be glad to know what occasion I have to look elsewhere for the cause, if it can be shown to exist in the "mechanical disadvantage" of the crank, or the mechanical disadvantage of any other description of shifting leverage?

Your correspondent's meaning of the term "loss of power" is this, that unless that loss is irrecoverable, it cannot properly be called loss, though there may be a "mechanical disadvantage," which may be neutralized by some contrivance, as a fly-wheel, for instance. If your correspondent had read my papers attentively, he would have discovered a mode much more effectual than a fly-wheel for gaining his object, for overcoming the mechanical disadvantage of the crank, and mending that defect. At page 470, vol. xxxv, I stated, that when the work required to be done by the engine, or rather the resistance which that work opposed to motion, varied in the proportion of the shifting leverage of the crank, then there was no deficiency of effect; as, when the weights of 56 and 28 pounds were put in motion by the shifting leverage, there was no loss. But no contrivance, as I before stated, placed between the first mover and the crank, or even the fly-wheel, would have that effect, and the work required to be done cannot have the varying motion above mentioned given to it in practice; but if it could, the effect would be, that the whole arrangement could not properly be called a crank action, because the power applied every instant was exactly equivalent to the work required to be done at the same moment; and a little consideration will show that a fly-wheel, in this arrangement, would be injurious.

Your correspondent states that, in all his papers, he never mentioned the word "friction," and it is very true he did not; he was too cautious to commit himself; but it is equally true that I did mention it, and that

all my arguments are built upon that important element in practical mechanics, though to the mathematician a most troublesome one. If your correspondent will take the trouble to look back, and read over again these experiments, about which so much has been said, he will find that they are introduced with the observation, that the crank, considered in the abstract, and without reference to friction, might, for all the purposes of my experiments and the line of argument made use of, be supposed incapable of losing power; and hence arose the necessity that my explanation should fully show, in the most practical manner, my meaning of the words "loss of power," but which he considers cannot properly be called other than a mechanical deficiency of effect. As I said before, I am perfectly willing to subscribe to this; but your correspondent must admit, that if my experiments prove that a "mechanical disadvantage," and a deficiency of effect, does exist in making use of the crank, or any other description of shifting leverage, which would not take place if the crank were removed, then in practice the deficiency should be considered due to the crank alone, and that it is a matter of the first consequence to remove it, if practicable to do so. And if the practical mechanic, seeing this, and endeavouring to give motion to machinery without the intervention of a crank, has an idea he can perform a greater quantity of work with one bushel of coals, by so doing, than he could with nearly two, when using the crank, I hope your correspondent will also admit, that all the gentlemen who wrote on the subject, in favour of his views, and considered such a person (and expressed themselves to that effect) as unacquainted with the first principles of mechanics, should withdraw such assertions, and make some excuse for having so inconsiderately expressed themselves on a subject, without having made themselves better acquainted with it.

Your correspondent mentions that, to restore the mechanical disadvantage, it is only necessary to procure a fly-wheel, the momentum whereof will restore any deficiency of effect to the crank. He will find, however, by referring to my experiments, and to my recapitulations of them, that I showed that want of momentum in the first mover was a cause of mechanical deficiency in any system of shifting leverages. How would he give momentum to the steam when applied as a first mover? The beautiful idea of a fly, by its momentum, accumulating and storing up power in one part of the crank's movements, to be given out where necessary, would be very well, if experiments could prove that no deficiency of effect took place by the shifting leverage at the moment of transferring power; but it becomes a mere fiction when the deficiency is proved to exist—when it is proved that the first mover cannot give over to the fly, through the medium of the crank, all the power, without any deficiency.

At page 71 in your last Number is given a paper read at the Cornwall Polytechnic Society, (these Cornwall engineers will certainly make your mathematicians go mad,) giving an account of a large steam-engine being applied to pump water to work water-wheels. This idea is not altogether new, for Watt originally employed steam-engines without a crank for that purpose; but it was reserved for the present day, and for a Cornwall engineer, to demonstrate by actual experiment, and on a sufficiently large scale, that it is much more economical to pump water for that purpose by steam, than to make use of a crank to the engine. Notwithstanding the well-known loss which takes place in working water-wheels, this mode had an advantage over the crank, in the proportion of 14 to 10. What, therefore, must the mechanical deficiency of the crank have been? Nearly one-half more work was, it appears, performed with a bushel of coals than when a crank was made use of. And this, too, though there was a considerable deficiency of effect in the working of the water-wheel.

Your correspondent's mode of making nice distinctions is amusing. In reference to a quotation from your Aberdeen correspondent he states, that instead of saying, "that one engine had nearly double the power of the other," I said, "your northern correspondent admitted that the crank engine did not do one-half the work of the other." I will leave it to the mathematicians to discover the difference: certainly, there was no misrepresentation or exaggeration in the case, on my part, although I quoted at the time from memory.

With respect to a misrepresentation, or rather, I should call it, an erroneous version, which your correspondent has given of my experiments, it is necessary to say a few words.

The facts stated in these experiments, (p. 259, vol. xxxv.,) your correspondent does not question; it is only the conclusions drawn from them that he quarrels with. The two weights of 56 and 28 lbs. were moved over a space of 6 inches by a power of 50 lbs. moving through a space of 4 inches perpendicular. This was done, be it remarked, by a shifting leverage, so arranged, that the power applied by means of the changing leverage was equivalent at the changes to the work required to be done. The weight of 56 lbs. had to be drawn 2 inches, with the full effect of the first mover moving 2 inches,

and 28 lbs. to be drawn 4 inches with that power reduced one-half by the lever, and moving 2 inches more. Your correspondent admits that a weight representing the average of these numbers, combined with the spaces passed over, namely, a weight of 37½ lbs. *could not* be drawn over the same space of 6 inches by means of the shifting leverage. Now, it is only necessary for me to prove, by the facts stated in that paper, that a weight of 37½ lbs. was actually drawn over that distance with a power represented by 50 lbs. moving through a space of 4 inches, when there was no shifting leverage, and when the power exerted was uniform and constant. This was performed; and had your correspondent quoted the passage which I now give, and which I complained that he suppressed, or did not give a correct version of, the true state of the case would be seen.

"I removed the cross bar from the table where these experiments were performed, and put the weight of 37 lbs. on the board *k*, and I attached the cord which passed from this board *k* along the table, and down the pulley to one end of a short lever of the third order, fixed under the table: I put the weight of 50 lbs. on this lever in such a position, that a motion of 4 inches given to this weight or power would cause the end of this lever, to which the line aforesaid was attached, to move 6 inches; by drawing back the board *k*, with the weights of 37 lbs. thereon, a few inches, this board and weight was moved over a space of 6 inches."

Now, was there any thing imaginary in this experiment? On the contrary, it is an experiment which, by the very conditions on which it is expressed—by the limitations given, render a practical trial unnecessary; for all that I require your correspondent to admit, and which he does not call in question, is, that the weight of 37 lbs. could not, when the shifting leverage was made use of, be drawn 6 inches. It will be observed, that 28 lbs. was the greatest weight which could be drawn when the cross-bar was made use of, and brought up to the stop by the power; but when I increased the leverage, when I attached the power to the lever under the table, a motion of 4 *inches* to the power imparted a motion of 6 *inches* to the end of the lever to which the string was fastened; whereas a motion of 4 *inches** in the power gave a motion of 8 *inches* to the end of the *cross-bar*, making use of the shifting leverage to which the string was fastened. It is not extraordinary that, under the former circumstances, 37 lbs. should have been drawn 6 inches, while in the latter case only 28 lbs. could have been drawn.

Let us for a moment longer confine our attention to this experiment, and connect it with the non-momentum apparatus, and see how the matter stands. Making use of the shifting lever or cross-bar on the table, and the friction-rollers, the greatest weight which can be drawn by the spring beyond the line mark on the table is 28 lbs.; by the limits the experiment is confined to, no greater weight could pass that line. Now let us remove the cross-bar, and attach the short lever under the table, and fix the spring to it, in the same position as before the weight of 50 lbs. had been placed. The leverage in this latter case will be to the leverage where the cross-bar was made use of in the proportion of 4 to 3. We have the proportion, therefore, as follows: as 3 : 4 : : 28 : 37⅓ lbs.; so that the spring, by means of the increased leverage, is enabled to draw 37⅓ lbs. over a space of 6 inches, whereas with the shifting leverage it could not draw a greater weight than 28 lbs. beyond the line; in other words, the same power being made use of in one case, and with a shifting leverage, a weight of 28 lbs. is the greatest which can be drawn; in the other, 37⅓. In this case I want your correspondent to admit nothing, and I challenge and defy him to question the truth of the experiment. "Oh! but," says my opponent, "recollect there is no steam consuming when the motion is retarded, and that it is in proportion to the work that it is consumed." I do recollect this very well; and I also recollect, that a much greater quantity of steam will be required to make the same quantity of work be done as when the shifting leverage is away.

I am not certain whether your correspondent may understand this explanation; but if your readers can, I am perfectly satisfied. I say I have doubts of his understanding it; and I have cause to think so, when he states that I am placed in a dilemma by an experiment he describes. Why, in all the experiments with the spring, the motion was confined to a space of 4 inches; and when I discovered what was the greatest quantity of work it was capable of performing, (the only object required,) why trouble myself about any quantity of work below it? An engine of ten-horse power will do the work of one horse, or any number under ten, but will not do the work of a greater number; but he wishes to build a calculation on the smallest quantity of work the engine can do. The problem reminds one of an ass race, where the beast last in wins the day. I hope he will not introduce the principle in the present discussion, and contend, by such dilemmas, that the person who has the worst of the argument is the most successful.

* Strictly speaking, it was a motion of 2 inches which gave a motion of 4 inches to the end of the cross-bar; but as this is the same proportion, it can make no difference, the line being made fast to the centre of the cross-bar.

Your correspondent has a curious mode of reasoning. He says it would be absurd to suppose that 74 lbs. could be drawn 3 inches, because 56 lbs. was, by the terms, the greatest weight which could be drawn; and at the same time he says, it is quite practical to do it by proper arrangements. No doubt it is; but I required the weight to be drawn 6 inches, and 37 lbs. was the greatest weight it could be done with, for a short distance.

Your correspondent asks me whether, in a steam-boat, where two engines are used, and two cranks at right angles, and no momentum, (as he says,) is required, I contend for a loss of power? I answer,—Without doubt, I do; and exactly to the same amount as if there were but one crank: and although, as at present constructed, the double crank cannot be dispensed with, it is on many accounts a most objectionable mode of working.

I am, &c., M.

## ABSTRACTS OF SPECIFICATIONS OF ENGLISH PATENTS RECENTLY ENROLLED.

JOHN GREEN THE YOUNGER, OF NEWTOWN, IN THE COUNTY OF WORCESTER, FARMER, *for certain improvements in cutting, or reducing turnips, mangel worzel, carrots, and other roots for food for horned cattle, horses and other animals.* Enrolment Office, September 7, 1842.

These improvements are stated to consist: Firstly, in the construction of a machine, or apparatus for reducing, or grinding into pulp and small pieces, turnips, and any of those roots which are, or may be used as food for cattle and other animals, and which roots have been previously cut into slices, or strips: and, secondly, in the combination of this machine with other well known machinery, or apparatus for cutting the said roots into slices or strips, so that when combined they shall form one machine, and perform the two operations simultaneously.

The machinery which performs these two operations of cutting and grinding, is very fully and clearly described, and illustrated by a number of well executed drawings. The grinding apparatus, which constitutes the principal, if not sole novelty, is composed of an outer cylinder, which has projecting from its interior surface, a number of spikes, or studs, which are cast upon it and arranged in circular rows; the spikes, or studs of the first row being longer than those of the second, and the second longer than the third, and so on—the spikes of each row gradually diminishing in length as they recede from the first row, and each row being at the same time a proportionately less distance apart (as are also the spikes themselves,) that is to say, the spikes themselves are closer together in each row in proportion to the distance it is situated from the first row, or in other words, the first row contains the least number, and the last row the greatest number of spikes or studs, and the intervening rows a number in proportion to their distance from these two extremes. At the lower part of the cylinder there are three boxes placed at equal distances apart, which each contain an adjusting plate hung upon a hinge, and capable of being moved to and fro by a screw. These boxes are used to regulate the fineness or coarseness of the pulp and small pieces, by being placed nearer to, or further from a wooden conical roller placed within the cylinder, which has a number of spikes, or studs, projecting from its surface, which are arranged in precisely the same way in every respect as the spikes upon the cylinder; but upon this conical roller, there are, besides the spikes, or studs, two rows of knives, each row containing four knives, which are equidistant from each other, and used to remove the pulp and small pieces from between the spikes or studs on the cylinder, which would otherwise be liable to clog.

*Claim.*—"Firstly, I claim that combination of machinery which I have described as forming a reducing or grinding apparatus, and also any other combination of mechanical parts for reducing, or grinding previously-cut pieces of roots into a pulp, and small pieces, in which combination the roots are operated upon by moveable surfaces, or by surfaces, part of which are moveable, and part of which are stationary, and upon which are placed spikes, or studs, or any other similar projections which will produce a like effect; and, secondly, I claim the combination of such reducing or grinding apparatus, with other machinery or apparatus (such as I have described for cutting the said roots into slices or strips,) but I lay no claim whatever to this cutting machine alone."

The patentee adds, "that the object in reducing these roots into a pulp and small pieces is, that they may be mixed with a portion of chaff, which makes a very economical and nutritious food for cattle." "It is obvious," he says, "that when fodder of an inferior quality is cut into chaff and mixed with a portion of ground roots, it would be much more eagerly devoured by cattle, than when the roots and fodder are given alternately."

The machinery may, he thinks, be also "beneficially employed in cutting or reducing apples and pears previously to being ground in the ordinary cider mill, which would very much facilitate and expedite the latter operation."

JOB CUTLER, OF BIRMINGHAM, *for im-*

*provements in the construction of the tubular flues of Steam Boilers.* Enrolment Office, May 6, 1842.

The inventions which are the subject of this patent are less "improvements in the *construction of the tubular flues of steam boilers,*" than improvements in *the mode of manufacturing* tubes in general; and it is in the latter sense, in fact, that the most important of them are claimed by the patentee. Nothing, however, is better settled than that a patent which is founded on a deceptive title, and linked to a specification which claims more than the title can possibly cover, is invalid (though possibly not past mending). What the inventions are, may be gathered from the claims of the patentee, which we subjoin.

"What I claim, as the first part of my invention, is the mode of welding iron or steel tubes, by drawing them through dies or between grooved rollers, when, and at the same time as, drawing such tubes or mandrils, the mandril being a necessary and important part of the mechanical apparatus in producing the welding.

"Secondly, I claim the welding of iron or steel tubes by hammering upon a mandril, at the same time I am drawing the tube from the fire along a mandril, so that the tube is welded on and drawn over a mandril at one process.

"Thirdly, I claim the application of either iron or steel tubes when coated with copper, brass or other alloys of copper, in the construction of tubular flues for steam boilers.

"And Fourthly, I claim in the construction of tubular flues of steam boilers, the application of welded iron or steel tubes, which have been drawn through a circular hole or die, or between rollers, and which have been drawn over a mandril, for the purpose of smoothing the external and internal surfaces of the tubes, and for regulating the thickness of the metal."

## NOTES AND NOTICES.

*Imprinting without contact or agency of Light.*—Mr. Breguet the celebrated watchmaker, has addressed a letter to the French Academy, in which referring to the discovery of Dr. Moser of Konigsberg, (see *Mech. Mag* No. 992, and p. 156,) that the figures of objects can be transferred from one surface to another without contact, or the agency of light, he states, that he has frequently seen on the polished inner surface of the gold cases of watches, a distinct impression in reverse of the name of his house, which had been transferred from the engraved letters, on the covering of the works, *which did not touch the case.* Our friend Mr. Prosser of Birmingham, has also informed us (before the announcement of Mr. Breguet's communication,) that having thrown a newspaper loosely on the top of a speculum, which was lying on a table with the concave side uppermost, he was sometime after surprised to observe, on removing the paper, and looking at the speculum, that there was a distinct impression upon it of several lines of the print, and that the impression was strongest in the centre, where it is certain no contact could have taken place. As there appears to be some difficulty in giving this new phenomenon a sufficiently distinctive name, we beg to suggest that it may very fitly be called after its first promulgator—*Moserotype.*

*Recovery of H. M. S. Magnet.*—Accounts from Sweden state that this vessel has been raised from the bottom of the Malmo roads, by means of a diving apparatus, invented by Count de Wenkerheing. Her masts, sails, and rigging are stated to be in good condition. In the hold were discovered three skeletons, and the body of a man in nearly a perfect state of preservation. The Magnet (built of oak,) mounting 18 guns, foundered in the above roads in the year 1809, thus making the time of her lying under water a period of 33 years.

*The Papal Steamers.*—The arrival in Rome of the three steamers constructed in England for the Pope, was the occasion of a popular feast, at which the principal functionaries of the State, the Cardinals, and a number of distinguished foreigners assisted. Notwithstanding the shallowness of the Tiber, the windings of the river, and the sand-banks which frequently obstruct its bed, the steamers ascended, in four hours, a distance which generally required nearly as many days.

*Continental Barbarism.*—The *Moniteur des Chemins de Fer* states that nearly one-half of the labourers employed on the Vesdre Railroad are females, who are preferred by the contractors to men for works of importance, from their superior docility, strength, and courage. "The country of Liege has," it is said, "this peculiarity, that the females undertake all those works which require superior skill and application that in other countries are reserved for men."

*Mines and Minerals of the United States.*—The production of iron, in 1840, amounted to 286,903 tons, in which 804 furnaces were employed; of bar iron the production was 197,233 tons, in which 795 forges, &c., were employed, the consumption of fuel for both these branches being 1,528,110 tons, while the amount of capital invested was 20,432,131 dollars, and the number of hands employed, including mining operators, 30,497. The production of lead amounted to 31,239,453 lbs., which employed 120 smelting-houses, 1,017 men, and an investment of 1,346,756 dollars. The production of gold was valued at 529,605 dollars, employing 157 smelting-houses, 1,046 men, and an investment of 234,325 dollars; and the production of all other metals at 370,614 dollars, affording employment to 728 men, with an invested capital of 238,980 dollars. From the coal mines the products were 863,489 tons anthracite, and 27,603,191 tons bituminous; in the former of which there was invested 4,355,602 dollars, and in the latter 1,868,862 dollars. From the salt mines the produce was 6,179,174 bushels, in the raising of which 6,998,045 dollars was expended, and 2,365 men employed. And the value produced from the granite, marble, and other stone works was 3,695,884 dollars, employing 7,859 men, with an invested capital of 2,540,159 dollars.



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## READMAN'S PATENT IMPROVEMENTS IN BAROMETERS.

Fig. 1.

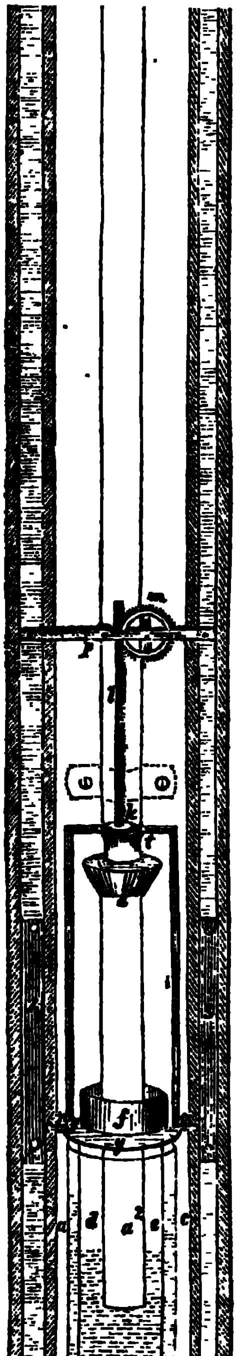


Fig. 2.

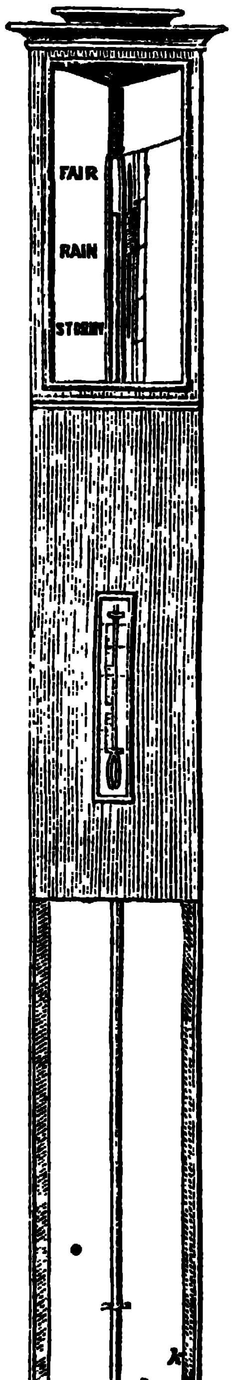
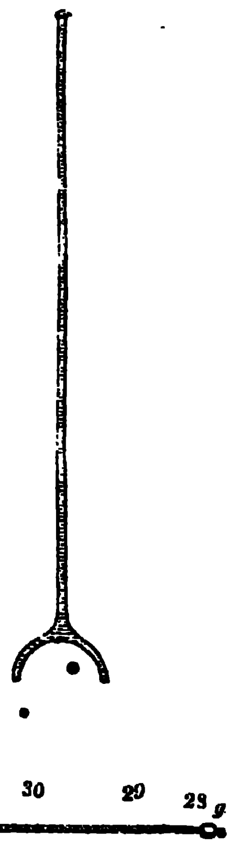



Fig. 3.



## READMAN'S PATENT IMPROVEMENTS IN BAROMETERS.

[Specification enrolled September 7, 1842.]

The improvements which are the subject of the present notice are founded on the following general considerations. In the common barometer, the pressure of the column of mercury, added to the atmospheric pressure on the surface of the mercury in the cistern, being equal to the atmospheric pressure on the exterior bottom of the cistern, it follows, that if we place the cistern, with its contents, upon the top of a spring, or other exactly adjusted balance, the depression caused in the balance will be no more than what is due to the weight at the moment of the cistern and its contents, independently of the barometric column —the weight of that column being counterbalanced by the atmospheric pressure on the exterior bottom of the cistern. But, as the mercury in the cistern is the source whence the barometric column is derived, and as the quantity in the cistern is increased or diminished according to the height of that column, it follows also, that as the barometric column is caused to rise or fall by variations in the weight of the atmosphere, so the weight of the cistern will be proportionally increased or diminished, and the spring, or other balance on which it presses, be to the same extent raised or lowered. It is further obvious, that if we ascertain how many inches, or parts of inches, are included within the extreme range of the barometric column, and what the weight of so many inches or parts of inches of mercury is, and to what extent the addition of such weight to the cistern will cause the spring or other balance to be depressed, we may from these data construct an index, which, being attached to the balance, will show on inspection the smallest changes in the height of the barometric column.

This, therefore, is what Mr. Readman, the present patentee, has done; and, by so doing, obviated three acknowledged defects in the barometers commonly constructed, namely, first, the difficulty of ascertaining the proper allowance to be made for the expansive effect of changes of temperature on the barometric column; secondly, the smallness of the range; and, thirdly, the disturbing influence of alterations in the level of the mercury in the cistern.

Fig. 1 of the prefixed engravings shows the manner of constructing a wheel barometer on this principle.

*a b c* is a cylinder containing mercury; *d e*, a second cylinder, which floats in the mercury within the other, forming the cistern of the barometer, (the mercury in the cylinder *a b c* serving the same purpose as the spring balance before spoken of;) $a^2$, the barometrical tube; *f*, a brass rim, which runs round the top of the cistern *d e*, and to the bottom of which is soldered the projecting circular plate, *g*; *h i* are two uprights, which are screwed into the plate *g*, and are united at top by a cross-piece, *k*; *l* is a toothed rack, which rises from the centre of the cross-piece, *k*; *m*, a toothed wheel, into which the rack *l* works, and to the axis of which wheel is attached the pointer of a properly graduated dial-plate; *n o*, anti-friction wheels, attached on each side to the projecting rim *g*, and which work in grooves in the frame-pieces, *r s*; *p*, a third anti-friction wheel, against which the rack *l* works as it rises and falls. To keep the rack in a direct line with the centre of the cistern, the tube of the barometric column is bent aside a little at *t*, as shown in the engraving. The mode of action is as follows. As the quantity of mercury in the cistern *d e* is increased or diminished the cistern rises or falls in the mercury contained in the outer cylinder *a b c*, and through the medium of the uprights *h i*, and rack and wheel *l m*, the exact amount of the rise or fall is communicated to, and indicated by, the pointer of the index. When it is desired to render this instrument portable, the plate *g* is brought close down upon the cylinder *a b c*, so as to serve as a lid to it. The instrument is then held in an inclined position, till the tube $a^2$ is completely filled; the tube $a^2$ is next unloosed from its fastenings, and pressed against the bottom of the cistern, which is protected by a piece of soft leather, after which the stopper *u* is slid down the tube $a^2$, and closes the mouth of the cistern.

By applying a fixed scale to the side of the tube $a^2$ of an instrument of the preceding description, very minute changes in atmospheric pressure might be rendered perceptible; for, besides the actual lengthening or shortening of the barometrical column by changes of pressure, such a scale would indicate the rise and fall of the cistern, the amount of which could be added to the range of the column. Thus, suppose the column to fall from 31 to 28 inches: if the cistern were

fixed, the scale would indicate a fall of only 3 inches; but if the cistern is made to float in mercury, in the manner before described, so that it rises and falls in proportion to any increase or diminution in the quantity of mercury in it; or if it is placed on a spring or other balance, which is affected in the same way, then the barometric column will have a farther fall, proportionate to the depression caused by the addition of the three inches of mercury to the cistern.

The patentee gives the following directions for graduating the instrument:—

"Assuming the extreme range of the barometric column to be 3 inches, the weight of these 3 inches should be ascertained, and an equivalent amount of mercury taken from the cistern, marking exactly the position of the index pointer, both before and after the operation. A quantity equivalent to the excess of the column above 28 inches is then to be deducted, and the remainder returned. For instance, supposing the weight of the 3 inches of the barometric column is 3 oz., and that the cistern stands at 28½ inches, you should then, (proceeding as above directed,) return only 2½ oz. instead of 3 oz., the ½ oz. being deducted to allow for the ½ inch which the barometric column exceeds 28 inches, and upon the flowing of which into the cistern the index pointer will be carried to its original position. The space included between the two points is to be divided in the usual manner."

Mr. Readman describes, also, a very ingenious arrangement, by which a barometer on his improved plan may have a balance on the steelyard principle applied to it. A representation of this arrangement is given in fig. 2.

*a b* is a metal cylinder fixed to the bottom of the frame or case which holds the cistern *c d*, (the diameter of the cylinder being a little larger than that of the cistern,) and which partly incloses that cistern. Round the top of the cistern there is a metal rim, which projects a little beyond the sides of the cylinder *a b*, and is bevelled on part of its under surface, to keep the cistern exactly in the middle of the cylinder *a b*; *e f* is a lever or steelyard, with a sliding weight, *g*, resting on a fulcrum at *h*: the short arm of the lever has a termination of a crescent form, (as shown in the separate view given in fig. 3,) the two branches or horns of which have conical points, which enter into corresponding holes in the rim of the cistern. To ascertain the height of the column, the lever is brought to a horizontal position, by causing the short arm to press upwards against the gauge-point *l*, simultaneously with which the crescent end of the same arm, catching hold of the rim of the cistern, raises it also, and, by means of the conical points inserted in the holes of the rim, keeps the cistern always at the same distance from the fulcrum. The sliding weight *g* is then moved towards the fulcrum, and the height of the column thus ascertained. The adoption of this plan will not interfere with the ordinary scale, which may be still retained in combination with it. When the steelyard lever is not required to be in use, it may be placed out of the way, in the vertical recess *i k*, to which there is an opening in the side of the framework."

To *register* the indications of his improved barometer, Mr. Readman judiciously avails himself of the newly-discovered art of photography:—

"I place at the back of the cistern, or spring balance, a circular plate of metal, covered in front with photogenic paper, of the same size as the dial-plate, and make the centres of the two plates to coincide exactly. Betwixt the circumference of the dial-plate and the graduated circle on the face of it there is a margin or border left, of about an inch and a half in breadth, and across this margin I make a narrow slit, directly over or under the centre of the plate. Behind the dial, and before this slit, I place a slip of metal, which is attached to the cistern balance, or spring balance, the bottom of which, when the mercurial column is at its highest point, is on a level with the upper end of the slit. Now, as the rising or falling of the cistern or spring balance increases or diminishes the length of the line of light admitted on to the photogenic paper, then, by causing the registering plate to revolve, (by a weight, or by any other convenient means,) a circular border is formed on the photogenic paper, the outer edge of which represents exactly the fluctuations in the atmospheric pressure. But, as the preceding method answers only for the day-time, I adopt the following plan when it is desired to continue the registration during both night and day. To the cistern or spring balance I affix a pencil, the point of which is made, by means of a spring, to press lightly on a surface of common paper stretched over the registering plate, so that on the plate being caused to revolve, (by a weight, or otherwise,) the pencil register, by corresponding lines on the paper, the rise and fall of the barometric column."

## IRON STATUARY.

Sir,—The following remarks suggested by certain recent Parliamentary grants of money for the erection of national monuments, will not, I hope, be deemed unsuitable to the pages of your valuable scientific miscellany,—open as they always are to the reception of any matter that may have for its object the promotion of public taste or utility.

It was proposed a few years ago, by a correspondent of your journal, (if I recollect rightly, Mr. Cheverton,) *to cast statues in iron*. From what cause the suggestion has not yet been adopted, I am at a loss to conjecture. The superiority of iron in point of economy over bronze admits not of a moment's doubt; and that being allowed, the only question which remains is, whether the durability of the former metal is equal to the test of centuries' exposure to the corrosive influence of a changeful and humid atmosphere like ours? Possibly it may not, if the surface is left in an unprotected state. But this may be the *single* objection to the employment of iron in monumental structures; and if so, an easy remedy for the destructive effects of *continual* oxidation is all that is wanted.

Now at the period the paper above alluded to was published, the electro-metallurgic art was unknown. It is by an application of this new art that I would propose to insure permanency to iron sculptures, by giving to each, as it were, an impermeable tunic of bronze. After a thin coat of oxide has been deposited on the cuprate surface, this first incrustation will arrest nearly all subsequent atmospheric influence—a fact well known and proved by the preservation of antique works in copper.

It may be almost superfluous to add, that the preparatory resistive process is very simple; for after the statue, group, or other work has been rifled and chased by the sculptor, the only requisites to completion are,—to chemically clean the surface by a short immersion of the objects in a dilute acid solution contained in a suitable vessel; to make a voltaic circuit with zink; and when the departation of all superficial pollution is effected, to precipitate the copper covering, which may be of any thickness deemed expedient.

We should thus obtain, also, at a trifling additional cost to the first cheap material, (besides its protection,) all the verdant beauty of the bronze metal. To illustrate by an example: suppose a column to commemorate the fame of some hero were to be erected; the shaft might be of plates, cast with flanched edges, joined by riveting, and disposed in courses, presenting a like superficial arrangement to the blocks in a column of stone. If an enriched design be desired, it can be produced with perfect facility, and made to record, with the finest effect, the victor's exploits, after the manner of Trajan's column, and other admired monuments. The capital might even be adorned by electro-gilding.

The electro-metallurgic art might be employed by itself to produce many sculptural works *wholly* in copper. Until now the great expense of peculiar glyptographic monuments has proved a prohibitory bar to their employment, independently of all constructive difficulties; but every objection on this score is now removed by an admirable process, that will ere long hold a prominent rank among the arts.

Great has been the lament of many at our inability to vie with the Egyptians in their litho-graving works. So numerous and consummately chiselled were they, as to baffle the imagination of the contemplator, and leave him lost in wonder at the inimitable skill and immensity of labour bestowed on their multitudes of hieroglyphic representations; making, as they did, the walls of their temples tomes, and converting their very sarcophagi into volumes. Our inability to approach, however, these magic, gem-like artificers in the chiselling of stone on a magnificent scale, is not so deeply to be regretted, when we reflect, that by graving a plastic substance we can, by simple after operations, in durable metal, and with identical fidelity to its pliant prototype, fabricate, with the utmost delicacy, chastity, and sharpness of execution, characters of lasting conformation. By the hands of artists of the present day monumental works could be produced in the grandest pictorial style, whose substantial bases might bear on their several facia the legends to be told to time. Permanent pictures like these, carrying objective grouping, with superadded in-

scriptions in different tongues, would form ponderous volumes of national biography, whose broad leaves, spread wide before the world, could be read by all wayfarers; serving, at the same time, to correct the public taste, and guide the judgment to a just sense of beauty in design. Copies of the original plates might also be multiplied indefinitely, so as to afford all our provinces and cities *fac-simile* devices, at a cost little beyond that of the crude material. These monuments to merit, of obelisk type, might be formed, each face separately, and conjoined subsequently to its fellows.

I am, Sir,
Your obedient servant,
J. S. Partridge.

Bankside, Sep. 7, 1842.

FURTHER REMARKS ON VOLTAIC CURRENTS.

Sir,—In calling your attention to the experiments of Aldini for passing a current of voltaic electricity through a great length of water, I had no intention whatever to dispute the ingenuity and originality of the experiments performed by Messrs. Wright and Bain; believing, as Mr. Wright informs you, that they were not aware that the same experiment had been previously and successfully made by Aldini.

However different the apparatus employed in the two experiments, yet the proportionate result is the same; and if the current produced by two square inches of platinum and one square inch of zink was detected by the delicate instruments now in use, it was necessary to employ a greater number of elements in the time of Aldini, as he had no means of detecting a voltaic current, excepting by its power to produce a shock. It is to be remembered, also, that Messrs. Cooke and Wheatstone consider it indispensably necessary to increase the number of elements of a battery in proportion to the length or distance of the telegraphic communication.

With respect to the gradual "dying away" of the electric current alluded to by Mr. Wright, it was discovered by M. Arago that a wire or conductor which has been traversed by a voltaic current continues for a short time in the same state after the circuit is broken, and produces the same effect as if it formed a part of a direct voltaic circuit. I imagine that Mr. Wright will find that the voltaic current will "die away" gradually as well when the wires are out of the water as when immersed in it.

Your obedient servant,
C. W.

TRANSMISSION OF ELECTRICITY—LIGHTNING CONDUCTORS.

Sir,—In the Mechanics' Magazine for August 27, I notice some experiments on the conduction of electricity made by Mr. Thomas Wright. He mentions "a curious and unexpected result," that the magnetism induced by the electric current did not vanish at the moment the electric current was suspended. Perhaps Mr. Wright will have the kindness to inform us, through the medium of your pages, how the induced magnetism was demonstrated, whether in a soft iron horse-shoe magnet, or simply by the action of a coil upon a magnetic needle. If in a soft iron magnet and the keeper was attached, the residuary magnetism on the cessation of the current of electricity has long been observed. But if a needle suspended in a coil continued to deviate after the current of electricity ceased, it is undoubtedly a newly discovered fact, and one well worthy attention. Mr. Wright would therefore confer a great obligation on all electricians, if he would give a fuller and more explicit account of the experiments than is contained in Mechanics' Magazine, No. 994, and if possible accompanied by a diagram.

In your Number for September 10, Mr. J. R. Hill, in writing on lightning conductors, mentions Mr. Snow Harris's plan, and that of Mr. A. Smith. I beg to say that the wire rope conductor leading from the royal mast-head to the lower mast-head, and from thence to the side of the ship, is a plan brought forward by myself some years ago, and published in most of the scientific journals of the day. Mr. Smith has therefore no claim to the invention. The position I have suggested for lightning conductors on board ships obviates the danger which ships fitted upon Mr. Harris's plan are exposed

to, in consequence of his carrying the conductor through the body of the ship, which is therefore exposed to all the danger of the lateral explosion—a danger Mr. Farraday recently demonstrated, in his usual able manner, to be very great.

Mr. Hill is in error when he supposes that "the electric fluid is conducted over the *surface* of metallic substances." Mr. Snow Harris also maintained this position for some time, but he has now seen his mistake. Electricity is conducted in a ratio of the *mass*, not of the surface of the conductor. Mr. Hill is right as to the advantage of continuity in the conductor.

Yours, &c.,
MARTYN J. ROBERTS.

1, Lower Grosvenor-place, Pimlico,
Sept. 20, 1842.

## GOVERNMENT CONTRACT WORK.

Sir,—I trust that as the following remarks are of considerable importance to London engineers, you will give them a place in your valuable Magazine.

Having paid a visit to the —— Dockyard the other day, my attention was drawn to a quantity of castings lying under a shed. On examination, I found them to be those of the ——— machinery, for the supply of which some of the London and country engineers lately entered into competition; and the order for which was given to a country house, because of its tender being the lowest. The consequence of looking to price only in such matters was here remarkably manifested. The castings are such as any London establishment would be ashamed to send out. Wheels with wooden cogs, with eyes to fit on turned shafts! The eyes, too, of these wheels exactly as they were cast—no such thing as boring about them! The key seats also in the rough, as they were cast, neither filed nor cut out by machinery in any way! The metal at the key seats actually drawn in the cooling of the metal, having been cast on mandrels! The malleable iron eccentric rods, also, that throw the work into gear, and work into journals of five or six inches diameter, rough from the hammer! In short, the machinery is altogether such as any London engineer would consider a disgrace to his establishment.

If London engineers are called on to compete with such work, I think it is at least proper that they should clearly understand that it is not to any superiority in workmanship they are to look for obtaining a preference; and that if they desire to have a tender accepted, they have only to make the figure low enough, and then make the work to suit the figure and their own pockets.

I am, yours respectfully,
AN ENGINEER.

London, Sept. 16, 1842.

## ON INHALATION AND PERCUSSION.—BY J. HARWOOD, ESQ., M.D., F.R.S.

Sir,—Observing that inhalation, when employed by invalids, was performed by the great majority of them either with instruments so unsuitably constructed, or in such a manner as to prevent the possibility of their deriving advantage from the process, I endeavoured, some years ago, so to reconstruct the Inhaler, as to render it a far more convenient and useful auxiliary in the treatment of diseases of the organs of breathing; and I also endeavoured to secure its proper employment, by offering a few very necessary rules for inhaling, which, I am happy to say, have produced much practical benefit, and have been adopted by some eminent members of the profession.

It is now my wish to say a few words, through your medium, regarding *percussion* as a mode of facilitating the detection of these and some other diseases. As the usual means of percussing, viz., striking the chest with the united extremities of the fingers, in aid of stethescopic examinations, is often equally feeble in its indications, and painful to the emaciated and sensitive patient, like some other practitioners, I have employed in these examinations, during some years, the intervention of a circular disk of a protecting material; and finding this method rendered the sounds of the chest somewhat more clear and sonorous, it led me to the construction of instruments for percussion of small size and of great simplicity, which, without inconvenience to the patient, make the indications of altered structure more ap-

parent. They consist of a hammer and one or more lenticular disks of various degrees of thickness and convexity. Though materials of less density and more elasticity, like the parts examined, are in some respects preferable, for greater convenience they are chiefly formed either of ivory or of hard and solid wood, the sonorous qualities of which are obviated by the intervention of a substance affording scarcely any sound of its own. Thus the striking surfaces of the hammer are armed with india-rubber, which I have found it necessary to cut into a pointed form, to prevent the intervention of air between the surfaces struck, the more effectually to diminish external sound. The different degrees of convexity of the disks, which are formed of wood or ivory, or india-rubber, adapt them to the degree of emaciation, and consequent concavities of the surfaces examined, though it is best to accustom the ear to the sounds elicited by one or two only. It is necessary that the disk should be firmly held, and pressed in close contact with the skin when struck by the hammer, that no other sounds be communicated than those produced by internal parts or cavities. And thus, not only within the chest may the sounds of parts examined and deeply concealed be obtained with increased distinctness, indicating the condition of the organs, and facilitating the detection of latent disease; but in dropsical effusions, and some other diseases, I employ this percussor with interesting effect and advantage.

Having used these instruments since the early part of the year 1840, ample opportunity has been afforded of proving their advantage; and I have placed patterns of them in the hands of Mr. Waugh, of Regent-street, in the hope that they may continue to be properly constructed, and thus rendered useful to others as well as to myself.

From, Sir, yours respectfully,

John Harwood.

West Villa, St. Leonard's, Hastings,
September, 1842.

## COAL WEIGHTS.

Sir,—Being a dealer in coals, and my trade requiring a great number of 28 lb. weights in different parts of my coal yard and on my wharf, I find that exposure to the weather, and the accumulation of dirt in the raised figures and loops of the lifting rings, cause the weights to be inaccurate. When the Leet Jury visit me twice or thrice a year, I am almost sure to be mulcted for some weights being too light by abrasion or casualties, whilst others are too heavy from dirt and compacted coal dust. I should be thankful if any of your ingenious correspondents would advise me how to keep my weights correct, or devise some means of weighing from 1 cwt. to 5 cwt. of coal. by a graduated lever on the principle of the steelyard. The weighing machine must be light, and moveable on small wheels, so that it may be removed from one coal-heap to another with facility, as we have sometimes three or four carts all waiting at the same time; it should also be low and flat, for the convenience of holding the bags whilst the coals are shovelled up. Our bags hold ten stones, which is as much as a man can ordinarily lift into his cart. I have been at great expense in providing good weights and weighing machines, and have as many as sixty weights of 28 lbs. each in use, and I am sorry to say that the rough usage to which they are exposed in the open air, with the removal in and out of boats, subjects me, unavoidably, under present arrangements, to the disagreeable circumstance of being fined by the jury; although the deviation of the weights is often to my loss, and not a dishonest gain, as some ill-natured persons are apt to infer. It costs me 8d. per weight of 28 lbs. to have them verified by the Inspector of weights and measures, who lives a long way off; and to remove such heavy articles in a cart has on several occasions caused them to be injured, and to be inaccurate immediately on having them adjusted.

What I want is a weighing machine for heavy commodities, without weights, or at least but one, for coals, linseed cakes, iron castings, and other bulky heavy goods, weighed on the wharf.

I am yours respectfully,

A Wharfinger.

IMPROVED BALL-COCK.

Fig. 1.

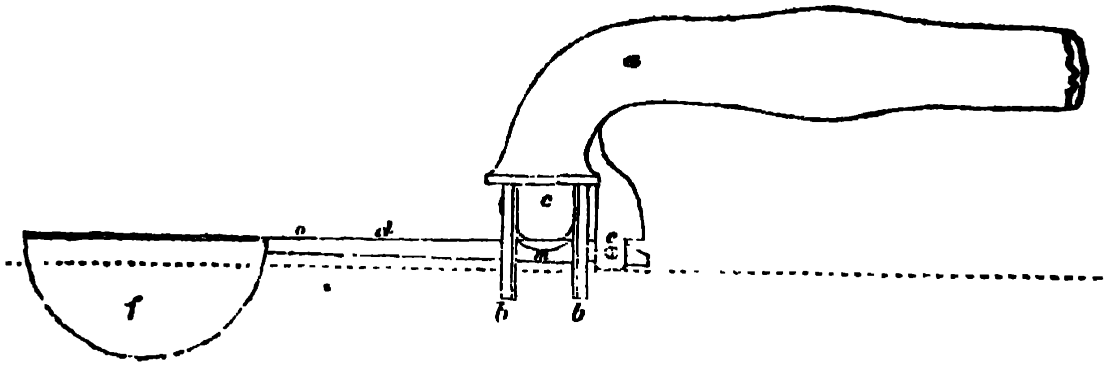



Fig. 2.

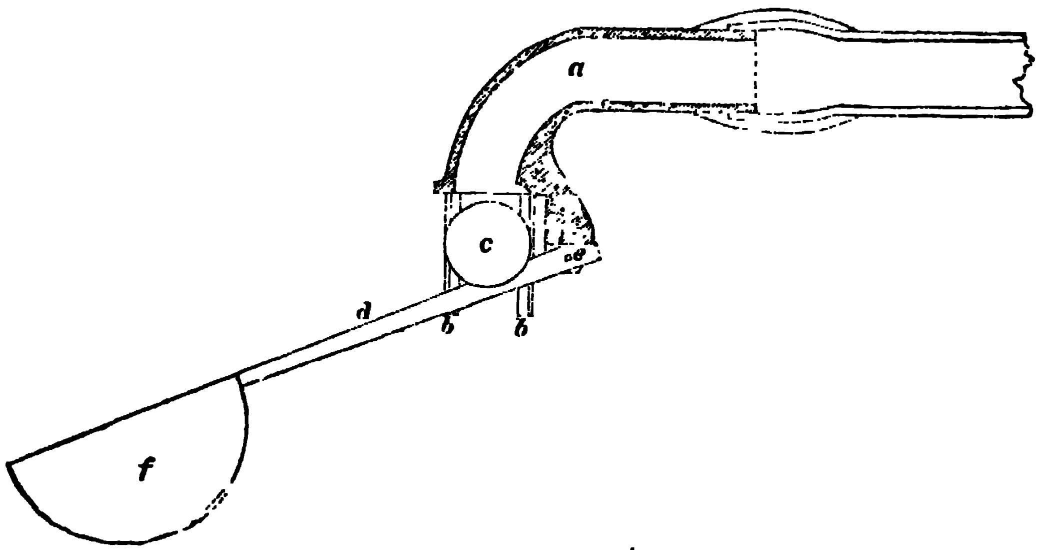
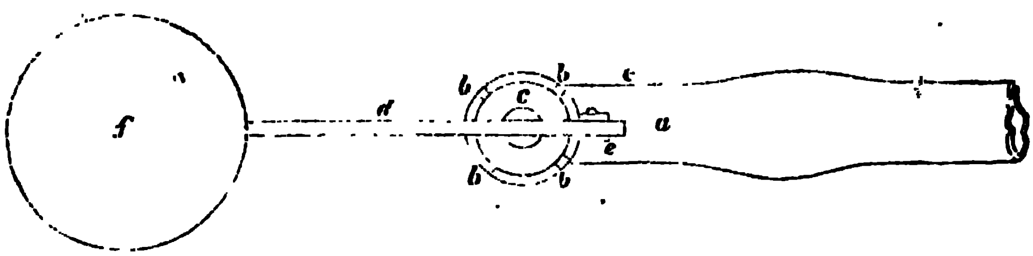



Fig. 3.




Sir,—The numerous defects to which the common ball-cock is subject have induced me to make the accompanying sketches of one which, I think, will be found to be free from most, if not all of these defects.

Fig. 1 is a side view. Fig. 2, a section. Fig. 3 a plan, looking from beneath. *a* is the cock, which may be cast with either a round shank, for soldering, or a square one, for connecting. The mouth is curved downwards, in the usual

manner, and has cast round it four square rods, *b b b b*, forming guides for the ball-valve, *c*, preventing its escaping when not pressed up into its seat by the lever-rod, *d*, which is jointed to an ear at *e*, cast on the cock; to the other end of the lever is affixed the copper float, *f*, which may be either a whole or half ball. A stop is provided at the jointed end, to prevent the lever falling so low as to allow the ball, *e*, to escape from the cage, *b b b b*, but yet sufficiently low to permit the escape of as much water as the service pipe can supply.

The action is sufficiently obvious, but may be briefly described as follows:—When the water in the cistern falls, the float, *f*, will fall with it, until stopped by the stop at *e*; the ball-valve, *c*, being no longer held up in its seat, will fall, and allow the water to rush in, as soon as it is laid on in the pipes; as the cistern fills, the float *f* will rise, and raise up with it the lever-rod, *d*, and valve, *e*, and press the latter tight into its seat, thereby preventing any more water entering. A small cup, *m*, is shown on the lever-rod, to receive the ball-valve, and prevent its getting bruised. The side view, fig. 1, shows the cock when closed; and the section, fig. 2, when it is open. In the former, the dotted line represents the level of the water when the cistern is full.

A hemispherical valve might be used instead of a ball, but it would require a spindle and joints, to prevent its turning round: or even a conical valve might be employed, care being taken to insure its rising truly into its seat; but the spherical valve is much to be preferred.

*Sticking*, which continually occurs with the common cock, (unless it is so loose as to leak,) can never, it will be observed, occur with mine. The diminished water-way, occasioned by the perforation in the plug being so much smaller than the bore of the pipe, is also obviated in this; since, by allowing sufficient play to the ball-valve, the cock will allow as much water to pass through it as the pipe can supply to which it is affixed; and the cistern, accordingly, will be filled in much less than the usual time.

I remain, Sir,

Your obedient servant,

E. M. J.

August 29, 1842.

## TAMPING WITH SAND, AND FIRING POWDER BY GALVANISM IN BLASTING ROCK.

Sir,—In doubtful matters, *theories* and *opinions* may be very erroneous; but *facts* in such cases must be of value.

Mr. James T. Wilson, in your No. 989, treats my remarks on tamping with sand as "Theory *versus* Practice," in which I think he is in error.

In an interesting paper on firing charges by galvanism in No. 978, it is stated to be the belief of Mr. Roberts, that "many hundred weight of gunpowder would be required to blow out a column of sand of two inches diameter and 18 or 20 inches in depth, placed in solid rock."

I asserted on the contrary in No. 983, that instead of requiring *many hundred weight*, *a single ounce* of powder would blow out every particle of the sand.

I ventured an *opinion* as to the cause of this fact; that opinion might be good for nothing, but still the foundation was the *positive fact*, and not a theory on which a result was presumed, as would seem to be implied by Mr. Wilson in calling it "Theory *versus* Practice."

Now I will mention another *fact*, founded on numerous trials.

In a hole of 1-inch diameter and 2 feet deep in solid rock, one quarter of an ounce of powder will blow out every particle of sand filled over that charge to the very top of the hole; while 3 oz. will not disturb a well-hammered clay tamping in a similar hole; and the relative effects will be nearly the same in larger holes with increased charges.

With these *facts* before us, I think the presumption is that for tamping, sand is far inferior to the tamping of clay or broken brick hammered down in the usual manner.

It is quite true that the effect of the explosion in splitting the rock is very rapid, and with tolerably large charges, will operate in that way quicker than it can force good tamping out of the small opening by which the charge is introduced; but where the sand shows such a great want of resistance as above described, it is impossible not to suppose, but that it is incapable of procuring the maximum effect from the explosion; and in small charges the loss must be very great.

It is not sufficient to say that great effects are produced in blasting rock with sand tamping: the question is, would they not be greater with different tamping?

By increasing the quantity of the powder, great effects may be produced *without any tamping at all,* merely by the resistance of the atmosphere.

An hundred weight of gunpowder placed in mass on the crown of an ordinary arch, and fired, without any loading over it whatever, will break through and destroy the arch. Gates of cities have been frequently blown in by suspending about the same quantity in bags against them and exploding it, as was done at Ghuznee.

Thus when rocks are blasted with sand tamping, the effects may be considerable, and yet not so great as they might be.

It is the more easy to be deceived on this point, as the results of my experience, and of many experiments, tend to show that usually much more powder is used in blasting rock than is necessary, and I should be glad to know by what rule Mr. Wilson is in the habit of apportioning his charges of powder.

Of the *superiority* of igniting charges by galvanism, *as an ordinary mode,* I am very far from being convinced.

I can quite understand its advantage under some circumstances; but I take it they would be few in comparison, and that the use of galvanism should be considered the exception, and not the rule.

Mr. Wilson is quite wrong in the statement, that the fuse is inapplicable under water; I speak of Beckford's patent fuse. There is a kind prepared expressly for using under water. I have tried it many times, and exploded powder with it, at from 25 to 40 feet under water, the fuse being lighted from the top, and it never failed. I know of rock being blasted with it to great advantage in from 20 to 30 feet water, by means of a diving-bell, to clear a foundation for a wharf wall. The holes were bored from the bell, and loaded each by a waterproof cartridge, to which five or six feet of the proper kind of fuse was attached; this was lighted in the bell, and the burning end immediately passed under the edge of the bell to the outside, to prevent the annoyance of the vapour to the workmen. The bell was then, according to signal, raised a short distance, and removed a little to one side till after the explosion, when it was lowered again to the spot for the removal of the broken rock, &c.

The operation was in this manner carried on rapidly, and I doubt whether any application of the galvanic battery could have been so advantageous.

I would strongly recommend no one to be deterred from the use of the fuse, until he has tried it well himself; the cost of trial will be small; the common kind is sold, I believe, at about one halfpenny per running foot; that prepared for water-work, called sump fuse, at a little more. The galvanic battery may be substituted afterwards, if it is considered desirable.

Sir, your obedient servant,

J. F. P.

## THE PATENT "BOCCIUS LIGHT."

The passing remark which we made on this "luminary" of the day, among the "Notes and Notices" in our 996th Number, has led to so many applications to us for further information on the subject—from our country friends more especially—and to so much complaint, also, of unmerited disparagement, on the part of the patentee and his friends, that respect for the reasonable curiosity of the former, if not for the matter-of-course chagrin of the latter, and a regard for our own reputation as honest and impartial journalists, combine to make it indispensable that we should explain more at large our reasons for the opinion we have expressed.

We shall first do the inventor—if so he can be called—the justice of laying before our readers a Report which has been made to him, on the properties of his light, by Professor Brande and Mr. Josiah Parkes, with a copy of which he has himself been good enough to favour us, and which he seems to look upon as so overwhelming an affair, that it leaves not a word more to be said!

*Report on Mr. Boccius's Patent Gas Burners; by William Thomas Brande, Esq., Professor of Chemistry, and Josiah Parkes, Esq., Civil Engineer.*

TO GOTTLIEB BOCCIUS, ESQ.

Sir,—Having requested us to make a series of experiments on your newly Patented Gas Burner, and to report to you

our opinion of its merits as compared with the burners in ordinary use: desiring also that we should pursue such methods of investigation as might seem to us most advisable for ascertaining the quality of the light produced, its illuminating power, and the general fitness of your invention for practical purposes, we have to report as follows:—

1st. We selected as the standard of comparison between your burners and those in *common* use, *the ordinary Argand burner*, consuming five cubic feet of gas per hour, and having a flame of from 2 inches to $2\frac{1}{4}$ inches in height above the jet holes.

2nd. The measurement of the quantities of gas consumed in a given time by the different burners submitted to experiment was determined by a *gasometer*, not by *a gas meter*; the former being considered less liable to accidental error, and to give more precise results than the latter.

3rd. With respect to the means adopted for ascertaining the relative intensities, or illuminating powers, of the several lights, we used both the method of shadows, and Professor Wheatstone's new photometer, which gave results in remarkable accordance with each other; the average results of the two methods, on numerous and frequently repeated experiments, not differing more than $2\frac{1}{2}$ per cent. Precautions were taken for measuring the respective distances of the lights from the instruments with strict accuracy.

The burners with which you furnished us for experiment were of the following diameters, viz.:—

| in. | in. | in. | | |
|---|---|---|---|---|
| $\frac{7}{8}$ | $1\frac{7}{8}$ | $2\frac{1}{4}$ | single ring | These dimensions have reference to the larger or outer ring. |
| | $2\frac{1}{2}$ | 5 | double ditto | |
| | | 7 | treble ditto | |

The light afforded by each of these burners is of a decidedly whiter, more brilliant, and more agreeable character, than that of the *ordinary* Argands; qualities which appear to arise from the more perfect combustion obtained by the arrangement of the apparatus of your burner.

The illuminating power of the light derived from an equal quantity of gas, was found, in your *single* burners, to be from 45 to 50 per cent. greater than the light given by the *common* Argand. In the *double* and *treble* ring burners, above specified, the economy amounted to at least 60 per cent.; and some experiments between your burners and the *batswing*, gave a still higher ratio in favour of your light.

Of the fitness of your burners for the general purposes of illumination there can be no doubt. Their construction is so simple, that no additional trouble or skill is required for their management; and as, with a smaller consumption of gas, they afford a larger quantity of light, the deleterious products of combustion must, in them, be relatively less than in burners of the ordinary kind. We are also of opinion that your burners are well adapted for the application of a simple and effective mode of ventilation, attainable by lengthening the central chimney, and, by its means, conveying away the heat of the flame, and the products of combustion.

We cannot conclude this Report without expressing our conviction that your invention is calculated to produce a valuable improvement in the art of illumination by gas, as well as to promote its more universal adoption for domestic purposes; inasmuch as the economy effected by your burners is not confined to the use of any particular size of light, but extends to all lights, whether adapted to the demands of a small apartment, or to the illumination of the largest halls, public places, buildings and streets.

We remain, Sir,

Your obedient servants,

WM. THOS. BRANDE,

JOSIAH PARKES.

London, August 2nd, 1842.

The first remarkable thing in this Report, which we have to notice, is, that the learned Reporters nowhere assign any *sufficient reason* for the superiority which they are pleased to assign to the "Boccius," over all preceding lights. It is stated to be "a valuable improvement in the art of illumination by gas," and something is said also about "more perfect combustion;" but *in what* "the valuable improvement" consists, and *how* the "more perfect combustion" is effected, the reader is left to find out for himself. If there were really any novelty in the construction of the Boccius lamp of a nature likely to render it preferable to others, why not tell us at once all about it?

Another remarkable thing is, that Messrs. Brande and Parkes should have thought of selecting, as "a standard of comparison," by which to test the value of the "Boccius Light," and the degree in which it is an improvement—a step in advance "in the art of illumination by gas"—the "*common Argand burner*." This is just as if the inventor of the last improved steam-engine were to ask us

to judge of its worth by comparing it with the rude atmospheric engine of a century ago. Why not select for the standard of comparison the *last best* light invented previous to the appearance of the "Boccius?" Why not take up the course of improvement where Mr. Boccius found it, and show what the advances really are which he is supposed to have made? So far as the truth of the case is concerned, the very learned and *most impartial* Reporters might as well have chosen for their standard of comparison, the oil lamps of the last generation, or the still older horn lamps of the days of King Alfred.

The reason for this selection of the *common Argand burner* for the standard of comparison, becomes abundantly manifest when we look to the results which the reporters obtained by it. "The illuminating power," they say, "of the light derived from an equal quantity of gas was found in your single burners to be from 45 to 50 *per cent.* greater than the light given by the *common Argand*; on the double and treble ring burners the economy amounted to at least 60 *per cent.*; and some experiments between your burners and the batswing gave a still higher ratio in favour of your light." Now all this might very well be, and yet the Boccius Light have nothing at all to boast of, over other lights well known to the public long before it was ever heard of. Dr. Ure, for example, says of the Bude Light, "It gives as much light as the *best* Argand gas flames *with only half the expenditure of gas.* A common Argand gas flame was found to emit a light equal to ten wax candles (8 to the lb.), and a Bude burner, called No. 10, gave a light equal to 94·7 of the candles. Thus, the Bude flame had nearly ten times the illuminating power of the gas Argand flame; while, by means of an accurate gas meter, the former was ascertained to consume only 4·4 times the quantity of gas consumed by the latter, *demonstrating the economy of the Bude Light over common gas to be* GREATER *than two to one,* and this economy *increases in proportion to the magnitude of the light.*" The results which Messrs. Brande and Parkes obtained from a comparison of the Boccius Light, with the common Argand burner, differ therefore in no respect from those which had been before realized by means of the Bude Light; and had they selected for their standard of comparison—as they ought in all fairness to have done—the Bude Light, by which the common Argand had already been so greatly eclipsed, they must have been compelled to report—special instructions and handsome retainers notwithstanding—that the Boccius Light, so far from being "a valuable improvement in the art of illumination by gas," has not advanced the art a single step.

Nor is it any wonder this should be the case; for if we pass from the Report of Messrs. Brande and Parkes, in which very prudently nothing is said as to the construction of the Boccius lamp, to the specification of the patentee himself, (see *Mech. Mag.*, No. 994, p. 212,) where of necessity he was obliged to explain in what his supposed improvements in combustion consist, we shall find that the means he employs (so far as the *production of flame* is concerned) are precisely the same as those employed by Mr. Gurney. Like causes could of course only produce like effects. Mr. Boccius supplies the gas to the burner through the medium of three concentric rings, freely exposed to the atmosphere, pierced at top with a great number of small holes; so also does Mr. Gurney. (See Mech. Mag., No. 981, p. 419.) Mr. Boccius "places the inner ring at a certain height above the outer one, or that next to it;" and he is careful to tell us that this arrangement "*he considers to be a great improvement on burners of the same kind heretofore made;*" but so also did Mr. Gurney, before Mr. Boccius reproduced this "great improvement"—as any person may satisfy himself who will be at the trouble to pay a visit to the shop of Messrs. Hitchcock and Rogers, St. Paul's Churchyard, which was fitted up during the last winter with Bude Lights, and where the construction of them can be inspected with great facility.

The only real difference between the two lamps consists in the chimneys; for whereas Mr. Gurney employs two chimneys, one rising a short way within the other, but both placed *at a little distance from the flame*, Mr. Boccius makes use of "two or more concentric chimneys, or cylinders, in addition to and *within the usual chimney of glass,*" the innermost of which chimneys is in *actual contact with the flame*, and which it is

therefore necessary to make of "thin sheet iron," or some other substance "capable of withstanding the heat." How any advantage can be gained from this multiplication of chimneys, or from the dipping of the innermost into the flame, neither Mr. Boccius nor his learned auxiliaries, Messrs. Brande and Parkes, have been pleased to explain, and we are ourselves utterly at a loss to divine. We are warranted by their own experiments in saying that there is in reality no advantage whatever; since it stands confessed that *no more light is obtained from the Boccius lamp, with its additional chimneys, than was before obtained by the Gurney lamp without them.* All the effect which the innermost chimney of "thin sheet iron," even when heated to the utmost, has, is to cast a dark shadow over the light; and, so far as this may be considered *an advantage*, Mr. Boccius must be allowed to have outstripped all competition.

We must guard our readers against assuming that, because we oppose to the Boccius Light the merits of the Bude, we have any desire to set up the personal rights or claims of Mr. Gurney against those of Mr. Boccius. We stated sometime ago (No. 981, p. 419) our reasons for being of opinion that Mr. Gurney is identified with the Bude Light more by false pretension than by original invention; and we desire to be understood as not departing from that opinion in the least. In speaking of him on the present occasion as the actual inventor, we have done so for convenience sake merely, waving altogether for the moment the question of historical truth. As far as Mr. Boccius is concerned, it matters not one jot how the question as to the invention of the Bude Light stands,—whether the credit of it belongs wholly to Mr. Gurney, or whether he only embodied the floating ideas and suggestions of others. Be that as it may, this at least is certain, that it was a thing done, *un fait accompli*, and a thing too of the greatest possible notoriety, at the date of Mr. Boccius' appearance on the scene. It is evidence decisive and unimpeachable of what the state of the art of gas illumination was at that date, and furnishes an infallible test by which to judge how far Mr. Boccius has carried us beyond it. Now we have seen that *before* the Boccius era, the common Argand lamp had been improved upon to the extent of *more* than 50 *per cent.*; and we have seen also that Messrs. Brande and Parkes claim for the Boccius Light a superiority over the same common Argand lamp of but *from* 45 *to* 60 *per cent.* The gain by the Boccius Light, therefore, is literally and truly NOTHING. The art of gas illumination remains just where it was before Mr. Boccius conceived the entertaining notion of giving it a lift by reinventing all that he found most approved in the existing practice, and stamping his own outlandish name on all that he could,—under favour of that vigilant guardian of the public rights, the Clerk of the Patents,—abstract from the public common.

## PURE WATER *v.* IMPURE CISTERNAGE.—MR. BADDELEY IN REPLY TO "B."

Sir,—I am sorry that your correspondent, "B.," (p. 282,) should have perused with so little care my communication in your 996th Number. Had he given that paper a little more consideration, I think he would have seen that in reality we differ but little in opinion, and not much in degree.

From this correspondence of opinion I must, however, except the assertion with which "B." commences his angry epistle—that "upon one point *all are agreed*, viz., that the water at present *supplied* in London is at once nauseous and noxious—that it is destructive to health, and often to life." To this mis-statement I give an unqualified denial.

That the water as at present supplied (by some of the Companies, especially) is susceptible of great improvement I not only admit, but I assert it; and I also uncompromisingly maintain the great desirableness of that improvement being carried to the utmost possible extent. I have not the pleasure of being acquainted with Mr. Stuckey's plan of filtration; but, from the statements put forth respecting it, I am quite ready to take for granted that it will effectually filter the required quantity of water, with sufficient rapidity, and at a trifling expense, and also be unattended with any of the deteriorating effects which many filters exercise upon the fluid passing through them. Further, I am also prepared to admit, that it would be beneficial if the several Water Companies could be induced, or

even compelled to adopt so excellent an invention.

The fact, however, is, that there are TWO sources of impurity in our water supply, of unequal magnitudes; and I hold, with your correspondent "B.," that it is "highly mischievous" to fix the public attention wholly upon one source of impurity, and that possibly the *smallest*, to the exclusion of all consideration for the other, which may turn out to be the *greatest*.

Now, in my former letter I stated that nine-tenths of the impurities to be found in our cisterns enter the water *after* it has been received from the Water Company. That is to say, that the quantity of impurities contained in, and supplied with the water seldom amounts to, and never exceeds, one-tenth of the whole. To this original and really minute quantity, continual additions are being made by the action of the wind, rain, &c., and the contents of the cistern become charged with blacks, dust, moths, flies, spiders, caterpillars, &c., with other animal and vegetable substances, according to the situation of the cistern.

Your correspondent, "B.," speaks of "an ascertained and proved remedy, which would prevent *any dirt from entering into our cistrens at all!*" Now, this is the grand desideratum, and if such a remedy has indeed been found, I shall rejoice to become acquainted with it; but I confess that in this matter "the eye of faith is dim."

What I wish to impress on your readers is this, that merely delivering a supply of *pure water* into our cisterns, as at present regulated, will be literally casting pearls before swine. "B." says, my present remedy "is good as far as it goes." I consider it undeserving of the name of "remedy." I merely suggest it as a precaution—a precaution necessary at all times, whatever improvements may hereafter take place in the *supply*. A precaution which, as far as it goes, will positively prevent any "destruction of health," or "loss of life," and therefore one that the public should well understand to be at their own command. It is a precaution, moreover, which, if still unattended to, must render nugatory all the care and expense that may be incurred to supply pure water. Our cisterns must be so closed as to exclude all those deteriorating substances which now so freely enter, and the whole mass of water must be frequently changed. A body of even "beautifully-filtered water," allowed to become stagnant, will be as noxious and unwholesome as any portion of that now supplied.

In consequence of the public attention being so frequently directed to what I maintain to be the *lesser* source of evil, I felt it necessary to call their attention to the *greater* also. To point out the *duality* of the mischief, and to show the *twofold* character of the remedy, was the object of my former paper. What I want is, to place the public in a position to second and give effect to any efforts which may be made, either voluntary or compulsory, to increase the purity of the supply.

The "levity," and "sneer at the notice on the order book of the House of Commons," rests entirely in the imagination of your testy correspondent "B." I consider the subject too serious for levity, and most unbecomingly subjected to badinage.

With respect to what "influential members of the government, or "noble lords," may have done, said, or promised in this matter, I do not know, neither do I care. No members of the government, however influential, nor any peer, however noble, can *alter facts*; that parties will be found ready enough to misrepresent them, there can be no doubt.

"B." cannot attach a higher importance than I do to the enquiry which is "promised;" and I will do him the justice to suppose that he desires nothing but *the truth*. I beg, however, to say that I desire more,—I desire the *whole truth!*

It is just possible, though barely probable, that the legislature may direct the water companies to increase the purity of their *supply*; but if they do not also direct the receivers to increase the purity of their *stock*, of what benefit will be their labours? The *purest* possible *supply*, added to an *impure stock*, will instantly become impure, and only perpetuate our present evils.

"B." parades the usual bugbears of his class, and speaks of "nauseous and noxious water,"—"diseases generated thereby,"—"destruction of health,"—"English cholera," and "loss of life."

I suppose "the friendly water of the Thames" is the worst that "B." can

produce, and yet how many living witnesses could be found who have, for more than three score years and ten, drank this (*slowly*) poisonous compound! I defy "B." to produce a single case of loss of life through drinking impure water; and further, I defy him to produce a single case of the slightest indisposition produced by water *as supplied by any of the public companies!*

If the impurities of the water came with the supply of that element, all houses on one service would be alike as regarded the state of their cisterns: while the fact is, that a constant variation is observed, regulated by varying circumstances.

The remarks of "B." have almost driven me into the position of an apologist for the Water Companies—a task as uncongenial to my feelings, as it is beyond my powers. It is very natural that "B." should treat my letter quite as "a matter of business," but he is most completely mistaken. I have no wish to "offer my services," for a consideration, "to wealthy corporations at the hour of their trial"—if such trial be approaching. I decline any such employment. It is now twenty years since I commenced as a humble, though zealous, and to some extent a successful, labourer in the task of reforming the water supply at fires—labouring at my own personal and pecuniary cost to benefit my fellow-men—or, as "B." would have it, to serve the wealthiest of corporations —and this without expecting, seeking, or receiving the smallest fee or reward. No great marvel, then, that during this period, and so employed, I should have had a more practical insight into the whole matter of water supply than casual or interested observers.

Having laboured thus far *pro bono publico*, I beg leave to say, that neither my age nor circumstances are yet such as to lead me to adopt that which Byron describes as a "good old gentlemanly vice."

Wishing "B." every possible success in the business to which he has *lent* himself, and expressing my determination to give him a push behind, on the manifestation of any "stop short movement,"

I remain, Sir, yours respectfully,

WM. BADDELEY.

29, Alfred-street, Islington,
Sept. 19, 1842.

## THE LATE CAPT. A. VIVIAN.

(From the *Mining Journal*.)

When such a man as the late much-respected and talented individual, Captain Andrew Vivian, of Camborne, passes from among us, "to that country from whose bourne no traveller returns," his death deserves more than a passing notice at our hands. Descended from respectable parents, he received an education fitting him for the station in life which he was destined to fill, and, from his thorough acquaintance with mineralogy and mining operations, the neighbourhood in which he lived derived immeasurable benefit. The renewal of the works of the abandoned Dolcoath run of copper mines, and North Roskear, which subsequently proved eminently successful, whereby a dense population has been kept throughout a series of years in constant employment, were the result of his exertions, as were also those of Crenver Oatfield and Wheal Abraham, Binner Downs, and Wheal Treasury, with similar results. In testimony of his invaluable services, the Dolcoath adventurers, through the late right hon. Lord de Dunstanville, in the year 1806, presented him with a handsome piece of plate, with an appropriate inscription. Being one of the principal mine agents of Cornwall, he was repeatedly required to give evidence before the House of Commons touching mining affairs, and, as such, mainly contributed to procure the allowance of debenture upon the Norway timber used and consumed in the mines. He was well grounded in the science of mathematics, and, as an engineer, ranked with the first of his day. To him, in conjunction with Trevethick, is the world indebted for the construction of that gigantic and wonder-working machine, the locomotive-engine—a distinction of which Cornwall may justly boast. The author of this brief sketch well remembers an evening in the year 1801, when Captain Vivian first made his experiments upon the common roads. Its novelty attracted together a great concourse of people; the leviathan machine proceeded through the town, treading the streets in the power of her might. Her deep breathings, as she ejected the steam at every stroke, and the fire and smoke escaping from her, gave a wild romantic effect to the whole scene, and led a quaint old lady to ask—What will they attempt next? at the same time exclaiming, she could compare it to nothing less than a walking devil. For this invention, in February, 1802, he obtained a patent, and shortly after sold the patent right to Messrs. Boulton and Watt, who also presented him with a superb piece of plate on the occasion. The extraordinary energies of the late Captain Vivian's character and

faculties and powers of mind were strikingly illustrated by the fact, that at one period of his life, besides that he was an extensive banker, which business he conducted with great credit to himself, he carried on a large business as a maltster, tallow-chandler, and general merchant—superintended the management of eighteen mines—was the confidential agent of several considerable landed proprietors—and, withal, was no inconsiderable experimental farmer. He was sincerely public-spirited, and ever found ready to join and promote every undertaking in his opinion calculated to conduce to public good, and posterity will acknowledge to him a debt of gratitude. Possessed of a great fund of wit and humour, he had the talent of relating anecdotes in a very amusing and agreeable manner, which, united to a remarkably cheerful and frank disposition, rendered him a most desirable companion. In acts of benevolence "large was his bounty, and his soul sincere." As a kind and indulgent parent he was never surpassed, and the fatherless never failed to find in him a friend and protector, nor did he ever permit deserving objects of distress to ask relief in vain. Early in life he became the confidential agent of the families of Trelowarren and Pendarves, and the estimation in which they held him is marked by the circumstance, that, although increasing age and infirmities had for several years incapacitated him for the duties of his office, the present baronet, Sir Richard Rawlinson Vyvyan, and Mr. Pendarves, M.P. generously continued his salaries to the last. He was for some years a consistent member of the Wesleyan Methodist Society, and died in the full assurance of a blessed immortality, on the 5th day of September, 1812, in the eighty-third year of his age. His memory will long be cherished and revered by his family, and a numerous circle of friends and acquaintances.

## NEW METHOD OF MEASURING THE VELOCITY OF SHIPS AT SEA. BY EDMUND BUTLER ROWLEY, ESQ., M.R.C.S.

The necessary and hourly operation of measuring a ship's velocity at sea is at present effected by means of a float attached to a line of considerable length, having at measured intervals knots on it, and which, when used, requires the attendance of three persons—one to hold the reel on which the line is wound, another the minute sand-glass, and a third to take charge of the log-line. The float being thrown overboard, when a certain length of line has run out, which is denoted by means of a piece of coloured tape, the sand glass is turned, and on

Fig. 1.

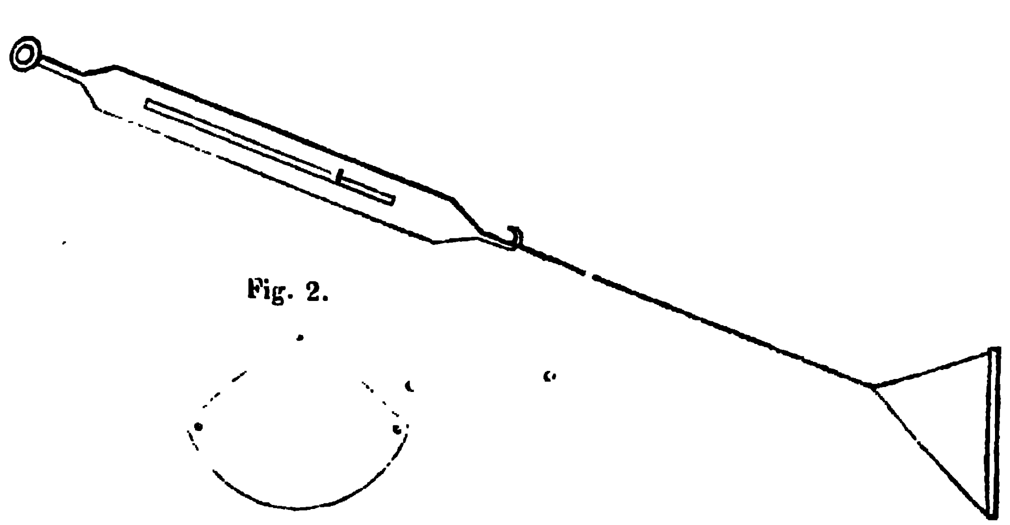


Fig. 2.

the minute expiring, the line is seized and hauled in to the first series of knots, which, should there be 8, signifies that the vessel is going eight knots or miles per hour.

By the contrivance represented in the accompanying sketches, the velocity may at all times, without any one's aid, be known. To the present float, fig, 1, which has its convex border loaded with lead to keep it upright, attach a cord of a definite length, say 20 or 30 yards, and connect its other end to a Salter's spring balance, as shown in fig. 2. Now as the resistance of the float increases with the velocity of the vessel,

this balance, by a few carefully conducted experiments, may be divided into *miles* in lieu of *pounds*. This being done, it is evident that if the float be permitted to continue overboard, the spring balance, or indicator, which may be fixed in some conspicuous place, will at all times denote the speed of the ship.

Manchester, Sept. 7, 1842.

### THE CRANK QUESTION.

Sir,—I am glad to perceive by your correspondent "M's." last letter, that he is now satisfied to allow, that his loss is but a "mechanical disadvantage," as I presume it augurs a speedy conclusion to our controversy. Your correspondent seems inclined to chuckle at what he considers a concession on my part; but he must have a very short memory if he forgets that this was the very position I took up, in my first letter on the subject; and that then he disclaimed such an idea with indignation; I brought it forward knowing that it was the rock many a practician had split upon, supposing that where a mechanical disadvantage existed, it must cause a loss of power. I shall just quote the passage (Vol. 34, page 389.) "When in any system, a power acts at a *mechanical disadvantage*, being by a lesser power held in equilibrio, so that no motion can ensue, it may be argued, that there is a loss of power suffered by the greater. This use of the expression, loss of power, which is not unfrequent, is, however, both highly objectionable and incorrect;—for if we say there is a loss of power in the lever, when by means of it, a greater power is held in equilibrio by a lesser, we must also say that there is a loss of power in the crank, when statically considered in a state of equilibrio. When, however, motion takes place, we immediately see how the matter stands; the doctrine of virtual velocities shows us that there is no loss of force whatever when the system is in motion, and therefore that there could have been none when it was at rest." I also used the following expression, "if 'M.' should still suppose that when there is a mechanical disadvantage, there must be also a loss of force, he may," &c.

Your correspondent, however, at that time would not at all give in to this idea, stating clearly in his reply, that he "did not contend that when a lesser power held a greater in equilibrio and that no motion ensues, that there must be a loss of power—nothing could be farther from his meaning."

Thus, then, Sir, my original supposition has turned out to be quite correct; but I do not on that account want to claim any victory in the matter; it was not for that purpose I commenced the controversy: and moreover, I am quite willing to permit your correspondent to be considered as victor, under the law which he tells us obtains among a certain order of quadrupeds.



You will think perhaps, Sir, that I might as well conclude here, the matter being comparatively settled; however, as I hope this will be my last letter, I dare say you will bear with me while I make a few further remarks on your correspondent's communication. I cannot but perceive that in several places he tries to make it appear that *I admit* that there is a "mechanical deficiency of *effect*" in the crank, in admitting a "mechanical disadvantage." I suppose he would contend that there was no difference; but, if there is not, *why* bring in a new expression at all? And if there is, (as there evidently is a great difference,) it is only another proof that *arguments* alone are not sufficient to support his cause. I used the expression "mechanical disadvantage," as I thought its meaning could not be mistaken, from its being so often used in works on mechanics, in treating of the mechanical powers, lever, pulley, &c., where nobody ever dreamed of there being a loss of force; so that your correspondent is greatly mistaken in supposing that I am ready to join him, in condemning those gentlemen, who he says, consider that any person contending for a loss of power in the crank, must be "unacquainted with the first principles of mechanics:" far from agreeing with him in this, I consider his own arguments strong confirmations of the fact.

In a former letter he had accused me of cavilling with him about friction. I denied the charge *in toto*, and now he says that indeed it is very true that *I* did not mention friction, *but* that it is equally true that *he* did! A pretty excuse this for an erroneous accusation! The reason he gives for my not bringing forward friction is truly absurd, viz. that indeed I "was too cautious to commit" myself; *how* I was to commit myself by mentioning it does not appear, and does pass my comprehension.

It seems now that it is friction which is to be blamed and not the crank; for he tells us that all his arguments are founded upon it, and, (what he never said before, though he thinks he did,) "that the crank, considered in the abstract, and without reference to friction, might, for all the purposes of his experiments and the line of argument made use of, be supposed incapable of losing power." This is a great admission, and goes far to clear up the character of the

crank, *if* it suffered aught from his aspersions.

My mode of making nice "distinctions" amuses your correspondent; he had much better have said nothing about the matter, than have provoked me to show him the difference between *work* and *power* more fully. "A Mechanic" told us that the crank engine scarcely exerted more than half the power of the rotary, in *lifting a weight*, for that if it had, it should have raised it with a *greater velocity*. Here, then, the less weight is raised with a great velocity, and the great weight with a less; so that for any thing we are told to the contrary, *exactly* the same quantity of *work* may have been done by each engine; nevertheless, your correspondent considers himself justified in stating, that the crank engine did not do one half *the work* of the other!

Your correspondent then favours us with a whole column about his original experiment; altogether overlooking what he himself has admitted, viz. that when the smaller quantity of work was done *a smaller portion of power was expended*, so that there *could have been no loss*, as I have fully shown in my last letter. He had therefore better give up his conclusions, drawn from this experiment, with a good grace at once.

I proposed a dilemma to your correspondent, (page 76,) which he seems totally unable to solve, but endeavours to reply to by objecting, that whereas in his experiment, the motion was confined to a space of four inches only, in mine it was confined still more, viz. to two. What the drift of this observation is, I cannot discover; but I can assure him that he is perfectly welcome to put four (or forty if he pleases) for two, wherever the latter number occurs in that experiment, (excepting the last proportion,) as it will make no alteration whatever in the result.

I cannot refrain from giving your readers, Sir, an explanation of a part of your correspondent's experiment, which he seems to consider quite a paradox. On the table we have a lever (which we call a crank) in which the power is to the resistance as 2 to 1, and we find that 28 lbs. is the *greatest weight* that can be moved by the given power with this lever. We now take away this lever, and bring another into action, (which, remember, is *not to be called* a crank,) in which the power is to the resistance in a diminished ratio, so that the leverage in the former case is to that in the present as 3 to 4, and "we have the proportion therefore, as follows; as 3 : 4 : : 28 . $37\frac{1}{3}$;" and, *strange to relate*, we find that now the same power will draw $37\frac{1}{3}$ lbs.! and we are defied to question the truth of this experiment!!!

As I do not wish to trespass any further on your valuable columns, and as there is nothing further in your correspondent's letter calling for notice, I shall waste no more time but conclude, remaining,

Your obedient servant,

R. W. T.

P.S. With regard to the cornish-engine at Wheal Uny, we are not told whether any, or at all events, an *efficient* fly-wheel was made use of, when the crank was brought into play: from the engine's being a pumping one, it seems most probable that there *was not*.

## RIVER STEAMERS—THE QUEEN, RAILWAY, BLACKWALL, &c.

Sir,—The letter of "L. P," in your Magazine, No. 996, p. 259, noticing some parts of my letter in a previous Number, p. 199, not being in all points exactly in conformity with facts, must be my apology for again troubling you, and making some furthe observations at this time in reference to the fast-going river steamers.

I must at once unreservedly admit that the fact of the owners of the *Queen* having tried her against (in "L. P." 's belief) the fastest boat on the river, viz., the *Railway*, is a proof of extraordinary confidence, and not only of confidence, but I had almost said, of considerable assurance; for it is notorious that few owners or makers of steam-engines are desirous of first running a new, unknown, and untried boat against the reputed Star of the day.

"L. P." asserts that the *Railway* on her passage up had no more passengers than were necessary to give her *proper trim*, nor more than the *Queen* would have gladly taken under the like circumstances." Now, as it has never been pretended that the *Queen* was *not* in proper trim on the occasion in question, it must follow, according to "L. P.," that she "would have *gladly* taken" on board what would have put her *out* of that proper trim! But perhaps he only means that her majesty would have been glad to have had such a silver freight to carry. It is to be feared that, as "L. P." on a former occasion could not discover a right measure to determine the true grounds for a victory, he has not yet been enabled to distinguish between the load necessary to give the proper trim, and the load which increases immersion, and of necessity lessens speed.

Speaking of the *Blackwall* beating the *Queen*, "L. P." asks, "how" I came to the conclusion I have done. In answer, I beg to say, that I have not jumped to it; it was the unsought-for testimony of three gentle-

men on board the *Blackwall*, who stated that they saw the *Queen* go down the river, and from the paddle-box of the *Blackwall* watched her progress; that the *Blackwall*, as near as could be ascertained by judgment measure, gained one mile, and in time, four minutes; but that none of them ever saw the *Queen* stop.

I now come to the "more fair trial," (in "L. P.'s" view,) on the 12th August, to which it would appear the feat of Samson carrying off the gates of Gaza is but a puny effort. "When Greek meets Greek then comes the tug of war;" and so it was. The *Queen* drew up alongside, bent on mischief, and started along with the *Blackwall*, the *Blackwall* carrying only feather weight (30 or 40 passengers), by "L. P.'s" measure, and the *Queen* 5 tons superfluous coals. The *Queen*, nevertheless, went round the head of the *Blackwall* in Long Reach. Happy for the *Blackwall* it was *Long* Reach; to have been so beaten in a short one would have damned her for ever. It would have been candid if "L. P." had informed the public, or rather, the scientific world, as he prefers, (which, by-the-by, I think is a stave higher up the ladder, than the common term public,) how this going round ahead in Long Reach was effected. As he has not done so, I will inform your readers. The *Queen* passed the *Blackwall* whilst making a stoppage; and the very moment she was again being put in motion, the *Queen*, as if convinced of being defeated, had the run been continued, took a course across the bows of the *Blackwall*, which had again to ease her engine to avoid doing damage to the *Queen*, which then rounded, and again proceeded down Long Reach.

In claiming victories for his *Queen* over the *Railway* and the *Blackwall* upon the grounds he has set forth, "L. P." evinces but little acquaintance with river practice, and the effect of varied cargoes. It is well known that even thirty or forty passengers in various positions upon a slight river boat will materially affect her trim. Neither is a general repair at the beginning of a season, to such hardworked boats as these, any guarantee for their being in condition, or at the top of their usual speed, six months after. The number of trips made, and passengers carried between Blackwall and Gravesend, with the continual easing, stopping, going astern, and again a-head, will readily explain to any one conversant with such practice, how utterly impossible it is that during their season, and under such circumstances, they can be found in fit and fair condition to run with new boats, prepared and brought out for "state occasions." Though "L. P." may satisfy himself that small-leaved laurel gathered from results like those he has cited are valuable, the public at least can justly appreciate them.

I have now only one other remark to offer,—for with the circumstances of the *Queen's* defeat by the *Isle of Thanet*, I am not acquainted; and it is this—that as no opportunity of a fair trial, under similar circumstances, has yet occurred, I would suggest that at the commencement of the next season, after the *Railway* and *Blackwall* will probably have been renovated, and be in a good average condition, the *Queen* should then take a run with them from Blackwall to the Nore and back, which, presuming they are freighted equally and managed with equal skill, would test their comparative steaming powers beyond all possibility of dispute. Or let them run day by day alike for a week or two, and then compare notes.

Having been guided in the statements I have made by the strictest regard to truth and fair play, and being not aware that any other construction can be placed upon them, I quit the subject with my best thanks to you for the kind and prompt attention you have given at all times to my communications, and for permitting them to find a place in your valuable, highly esteemed, and useful publication.

Believe me to remain, Sir,
Your obliged and obedient servant,
VERITAS.

September 15, 1842.

## INSTITUTION OF CIVIL ENGINEERS.
### June 7, 1842.

*"An Account of the Alterations to Tullow Bridge." By Charles Forth.*

The old Bridge at Tullow, over the river Slaney, was very dangerous from its steepness, its narrow roadway, (only 18 feet wide,) and the awkward approaches to it; alterations were therefore determined upon, for which the author submitted a plan, and also superintended the execution of it. The floods forbade any diminution of the waterway, and it would have been inconvenient to have raised the approaches on the low banks on either side; flat arches of the subjoined proportions were therefore decided upon.

The inclination of the roadway was thus reduced from one in seven to one in forty, while at the same time, by adding to the abutments on the up-stream side, the width of the roadway was increased from 17 feet to 28 feet, and, by completing a portion at a time, the thoroughfare over the bridge was not at any time stopped. For the sake of economy, the work was done in undressed rubble granite, with an ashlar face, taking

| | Span. | Versed Sine. | Proportion of Versed Sine to Span. | Diameter of Circle of which the Arch is a Segment. |
|---|---|---|---|---|
| | Feet. | Ft. In. | | Feet. |
| Land Arch........ | 17 | 0 7 | $\frac{1}{29}$ | 120 |
| Second Arch...... | 22 | 1 6 | $\frac{1}{14}$ | 110 |
| Centre Arch...... | 28 | 2 3 | $\frac{1}{12}$ | 110 |

care that the stones abutted well against each other, and on removing the centres, no settlement of any importance took place, and the traffic of loaded cars, weighing 35 cwt. each, was carried on without any danger, within a week from the time the arches were keyed. The expense of the alteration was only 485*l*., and it has stood well, although it has been subject to some heavy floods.

A detailed drawing of the bridge, before and after the alterations, accompanied the Paper, and Mr. Vignoles sent with it an enlarged plan, section, and elevation, for the purpose of more fully illustrating what he considered a successful work.

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"*On the Introduction of Letter-press Printing for Numbering and Dating the Notes of the Bank of England.*" *By Thomas Oldham, Assoc. Inst. C. E.*

The author commences by noticing the numbering press invented by Mr. Bramah, and adopted in the Bank of England in the year 1809, by which the expense and uncertainty of finishing annually a large number of bank notes, with the pen, was materially diminished, and forgery was rendered more difficult; although the machine was so far incomplete, that it produced only units, the tens and hundreds requiring to be brought forward by hand.

In that year, (1809,) the late Mr. John Oldham, (the father of the author,) offered unsuccessfully to the Bank of Newry a machine similar in principle to that of Mr. Bramah, but with the additional power of effecting numerical progression, from one to one hundred thousand, by its own operation. In 1813, these machines were adopted at the Bank of Ireland; and one of them was subsequently attached to each press for printing the body of the notes, in order to register and check the number of notes passing through the press.

In the year 1819, Mr. Bryan Donkin invented a counting machine, which is described in vol. 37 of the Transactions of the Society of Arts; it is called "a machine applicable wherever it may be desirable to keep an account of the number of revolutions or strokes, which may be made by the wheels or levers of any other machine, in a given time or space; as for instance, the number of revolutions made by a mill wheel, or of the strokes of a steam-engine beam in a given time, or the number of revolutions made by the wheel of a carriage or perambulator on passing over a certain space." This machine, like all the others used for a similar purpose, depended upon the relative motion of a series of ratchet wheels with projecting rims, having notches cut in them, so that when the first wheel counted units, the second wheel indicated tens, and so on progressively.

The principle of these machines was carried out in a complex manner, which required very neat adjustment to prevent their being deranged while working; the author after he succeeded his father as engineer to the Bank of England turned his attention to this point, and the result has been the production of the machine described in the paper.

Four wheels, each divided by ten notches, leaving a facet between each, engraved with consecutive numbers from 1 to 0, are placed upon a shaft, a portion of their breadth being turned down about one-half of their depth, having a boss or collar between each; upon these bosses and filling up the spaces, rest latches, and over each wheel is a pall, the width of the first being equal to that of the unit wheel, and the breadth of the others equalling that of the wheel and latch;—the palls are driven by a crank, by each revolution of which, the first wheel is moved through a space equal to one-tenth of its entire circumference, bringing regularly forward the numbers from 1 to 0, at which point, the latch of the second wheel is depressed, and the wheel moves forward one division, marking the tens; the same process is repeated with regard to the other

wheels, and thus any amount of numbers can be registered, by simply increasing the number of wheels in proportion.

Machines on this plan are now generally adopted in the Bank of England with perfect success, and in some cases they are added to the Bramah numbering machines; and as the author believed that they might be adapted to other purposes than Bank-note printing, he presented the drawings and description of them to the Institution.

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June 14, 1842.

"*On Iron Sheathing, broad-headed Nails, and Inner Sheathing for Ships.*" *By J. J. Wilkinson.*

These three papers complete the subject which the author commenced in the year 1841, and continued during the present session.

The first treats of the use of beaten iron, and iron nails, even in very ancient vessels, their corrosion, and consequent abandonment; the attempted introduction of rolled iron for the purpose of sheathing. It touches lightly on the construction of iron vessels, and on various attempts to protect them, which experience has now shown to be unnecessary, as the first iron steamer built by Mr. A. Manby in 1821, at the Horseley iron-works, has been in constant use on the river Seine up to the present period, without showing any symptoms of oxidation, although the only precautions taken have been to apply a coat of pitch, as often as to a wooden vessel. Extracts are then made from Mr. Grantham's treatise on "Iron as a material for Ship-building." A list is then given of the patents connected with iron sheathing and the various modes of preserving it from corrosion, alluding particularly to the valuable labours of Mr. Mallet (of Dublin) on this subject in the archives of the Institution.*

The next division treats of metallic sheathing or a coating of metallic oxide, formed by driving broad-headed nails nearly in contact with each other, into the sheathing board; this process is called filling. The nails used for this purpose by the Romans, were of the same form as those of the present day. There are authentic records of "filling" being generally in use in this country in 1666—but it is conjectured that it was practised much antecedent to that time, and it has continued in use until recently in Swedish and Danish ships. This mode of protecting the piles of harbours and piers from the ravages of the worm is then treated of, and examples are given of its success in various situations.

The third division treats of the inner coating or sheathing, which it has been found necessary to use, independently of the external metallic sheathing. It is stated, that some of the stronger and more adhesive kinds of inner sheathing, have proved mainly instrumental in preserving vessels from sinking, when the outer sheathing has failed or been destroyed.

Hair is noticed as among the earliest materials used for inner sheathing; it was usually applied in a loose state and fixed by pitch or other resinous substances; it was subsequently woven into and used as cloth—the coarse part of flax was in the time of the Romans bruised and driven between the seams of their galleys. A vessel was discovered in the Mediterranean Sea (between the years 1458 and 1464) in a depth of water of twelve fathoms, where it is supposed to have lain for nearly fourteen hundred years; the deck and sides were covered with paper, linen, and leaden plates. In all the oldest vessels which have been discovered the hair was perfectly fresh, although the timber was in a state of decay, and it is stated that the worm never penetrates through an inner sheathing of hair. In the year 1761, when copper sheathing was introduced, experiments were tried upon different kinds of paper for lining, and after trying white-lead and other substances, thick brown paper dipped in tar was found to be the best.

A list is then given of the patents for different kinds of "felt" now used for inner sheathing—noticing particularly that of Messrs. Borrodaile and Co., which appears to be that which is most generally approved. Cocoa-nut fibre and cork, and many other substances, which have been tried at different times, are noticed, and the paper concludes with a copious list of the experiments upon the subject, which the author has compiled from various sources.

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"*On the Sinking and Tubbing, or Coffering of Pits, as practised in the Coal Districts of the North of England.*" *By Robert Thomas Atkinson, M. Inst. C. E.*

This communication describes the means usually adopted in the Northern coal districts, for effecting the "winning" of those valuable mines, and the author expresses the obligation he is under to his uncle Mr. Buddle, to whose valuable documents he had free access during the progress of his labours.

It commences with noticing the early periods of mining, before the introduction of steam power for pumping, when the extrac-

* In a letter from Charles Wye Williams, Esq., dated Dublin, August 21, 1842, he says, "The old iron steamer called the 'Marquess Wellesley,' built for Mr. Grantham at the Horseley Works, is still working and in good order. I went in her recently through Lough Ree and some of the tributary streams that run into the Shannon." (Sec. Inst. C.E.)

tion of coal was almost wholly confined to such tracts as could be drained by free water-courses, "adits," or levels; the chain and bucket pumps, and other limited and expensive means, are then explained, with the principles of free drainage, showing that it was generally only applicable to districts of small extent, and that the best mines were left untouched.

Steam-engines upon Newcomen's principle were first used in the Newcastle district in the beginning of the last century, and they underwent many modifications, before they were superseded by the Boulton and Watt engines now generally used. The consequence of this introduction of steam power for raising coal, instead of accomplishing it by means of horse gins and other rude contrivances, is that the capability of supply appears only limited by the demand.

Over and above the weight of coal raised, it is necessary to draw immense quantities of water for the purpose of draining the mines. In some collieries the weight of water pumped up, amounts to as much as four times that of the coal raised. At the Percy Main colliery (which is rather an extreme instance) 3922 tons of water are pumped up daily, while only 636 tons of coal are raised in the same time. At the Benwell colliery, which is an average case, the weight of water amounts to 2020 tons per day and the coals raised to 768 tons or 38 per cent. of the weight of water.

The principal technical mining terms in use in the northern districts, are then explained, and the author proceeds to describe the methods of sinking the shafts, noticing the difficulties which occur in traversing the strata of various kinds, and the modes of overcoming them—the temporary timbering with "cribs" and "deals" previous to walling—and the different kinds of "tubbing or coffering" of wood, stone, or cast-iron, used in passing wet portions of the strata or perishable rocks; this part of the subject is treated of very fully, with all the details of the construction of the different kinds and the methods of using them. The cast-iron tubbing, which was first introduced by the late Mr. Buddle, is particularly noticed, as is also its use in segments at the Percy pit in the year 1779; some instances are given of the decomposition of cast-iron tubbing and pumps, when exposed to the smoke of underground furnaces and the action of mineral water, the combined action of which has been found to reduce the metal to the consistency of plumbago.

The construction of the pumps, buckets, clacks, rods, &c. composing the apparatus for raising the water from the mines, is then fully described, with the "off-take joints" and the "fish-head" for drawing a "drowned clack." The "hanging sets" or columns of pumps, with their "ground spears" used in sinking the shafts, are also described, with the method of fixing the cisterns at intervals in the shafts, for the different sets of pumps, which are all of the "lifting" kind.

Accounts are then given of the sinking of Percy pit, Flatworth colliery, commenced in 1799—of Howden pit, Percy Main colliery, in 1804—and of a pit at the Barrow Field colliery in 1822, in all of which, great difficulties were encountered.

An explanation is then given of the extensive and complete set of sections of pits, drawings of the machinery, and of the models which accompanied the paper, and the author promises to extend the subject on a future occasion, as this communication is less comprehensive than was intended, and has been sent in its present state for the purpose of complying during the session, with the usual condition of election.

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June 21, 1842.

"*The History of the Canal of Catwyk (Holland) with a description of the principal Works.*" *By the Chevalier F. W. Conrad. Translated by Charles Manby, Secretary, Inst. C. E.*

This communication is divided into three parts:—1, The Introduction; 2, The History of the Canal of Katwyk; and 3, A Description of the principal works.

1. The introduction gives the general outline of the locality of this canal, which is probably one of the most useful and extensive works undertaken in Holland, for the purpose of draining the low lands and rendering them capable of cultivation; it is carried in a north-east direction from the village of Katwyk-binnen through the sand-banks to the North Sea, where it is terminated by five sea locks: it was undertaken for the purpose of draining the district called "Rhynland," a succinct account of which is given, with details of the early attempts at draining, such as the embankments of Marendyk, those of Spaarndam, &c., tracing them up to the time of Count William the Second, king of the Romans, in the year 1253; at which period the level of the district was identical with that of the medium tide, and each "Polder" (or spot of cultivated land) was separately protected from the spring tides by an embankment; a change has occurred in the relative levels, whether by the sinking of the land or the elevation of the sea is, it appears, a subject of dispute, but it is certain that the level of the river Y and of the Zuyder Zee is now much above that of the Rhynland district.

The natural consequence of this change, has been to increase the demand for artificial drainage by canals, and of windmills for pumping, and also the establishment of local boards of direction, whose duty is the superintendence of the works for the protection of the lowlands.

The district of Rhynland contains 127,000 bonniers or 317,500 English acres, which is thus divided :—

| | Bonniers. | | English Acres. |
|---|---|---|---|
| 1. Polders, or Districts embanked and drained by windmills .................. | 54,831 | = | 137,077·5 |
| 2. Lakes and Peat-bog already laid dry.... | 15,262 | = | 38,155·0 |
| 3. Land without mills and sandbanks on the borders of the North Sea............ | 32,630 | = | 81,575·0 |
| 4. Lakes, Canals, Ditches, Peat-bogs abandoned, &c....................... | 24,277 | = | 60,692·5 |
| | 127,000 | = | 317,500·0 |

The drainage is effected by two hundred and sixty-eight windmills, working scoop wheels, or Archimedes screws.

Within this district, is included the Lake of Haarlem, which alone extends over 18,000 bonniers or 45,000 English acres; the drainage of it is now commenced and will restore a tract of very valuable land.

The enumeration of the original locks at Spaarndam and other places, is given, showing their incapacity for carrying off the waters, particularly when unfavourable winds prevented their free current into the Y, and hence the necessity for the canal of Katwyk and the choice of that particular spot, which is not affected by the prevailing winds.

2. The historical portion of the memoir treats of the naturally unfavourable position of the district for drainage; it mentions a project for a canal at Katwyk in the year 1404, as related by Professor Lulofs,* on the authority of the historian Van Mieris; and enumerates all the various examinations of the levels, the projects of tunnels, canals, &c., the appointment of numerous committees, the local opposition to the several plans, the repairs of the embankments, which had become so expensive that the landholders abandoned their estates, rather than pay the cost of preserving them; the attempt to form a small canal through the sandbanks, which was either closed by a heavy storm or was suffered to fall to decay; the effect of the siege of Leyden by the Spaniards in 1573-4, when, instead of draining the country, every attempt was made to cause an influx of the waters to annoy the invading army. It appears that subsequently the expense of renewing the hydraulic works would have been so considerable, that they were in a great measure abandoned for a time. In 1627, attention was again given to the subject, and Katwyk was pointed out as the only spot for an effectual system of drainage. The map by Bolstra, which the author promises to send, shows all the plans with great precision.

The reports are then given of all the various engineers and scientific men, on the drainage of the Lake of Haarlem, in all of which the Canal of Katwyk is a principal feature. The very able tract by Mr. Twent on the state of the drainage of Rhynland, and the necessity for a canal at Katwyk, is mentioned as one of the principal causes for its final construction. After the publication of this tract, Mr. Brunings, in the year 802, caused the nomination of Mr. Conrad (the father of the author) and Messrs. Blanken, jun. and Kros, to report upon the project; which they did with such effect, that in May 1804, it was ordered to be executed by the reporters, under the superintendence of Mr. Brunings, the director-general of the "Waterstaat;" the plan selected being that which was laid down by Mr. Conrad. In August of the same year, the works were commenced, and in 1805, were so far advanced, that in June the first stone of the inner lock was laid: Mr. Conrad, who in consequence of the decease of Mr. Brunings had assumed the chief direction, carried on the works with such activity, that they were entirely finished by the month of October 1807, without the occurrence of any accident, although they had to support several very severe storms during their progress. On one occasion just as the masonry of the locks was finished the level of the tide was raised by a storm 2·36 metres (2·54 yards) higher than usual, carrying away the external cofferdam, but such was the solidity of the masonry that it resisted perfectly.

* Lulofs' Treatise on the elevation of the Sea and the Depression of the Land on the coasts of Holland. Transactions of the Society of Haarlem, p. 1, f. 88.

A steam-engine was fixed for pumping up a head of water for scouring the sand from the exterior canal; and the final opening of the canal took place with great ceremony on the 21st October, 1807, when a medal was struck to commemorate the event, a copy of which is given by the author to the Institution.

Mr. Conrad made a series of experiments which completely proved the efficacy of the works, and then was carried off within the short space of three months from the termination of his successful labours, which will hand down his name to posterity, as the projector and executor of one of the most useful engineering works on record.

A slight sketch is then given of the origin of the Lake of Haarlem, the causes of its extension, and the works already executed in anticipation of its eventual drainage.

The third part consists of a detailed description of the principal works at Katwyk, with their dimensions, and the necessary references to the drawings which accompany the paper.

The length of the canal from the Rhine to the sand-banks near the lock, is 2260 metres (2471·53 yards) of an average depth of 2·20 metres (2·40 yards) beneath the conventional height of tide for the kingdom of Holland, from which all tidal measures are taken; it corresponds with the average tides of the river Y; the common tide at Katwyk falls 0·60 metres (0·65 yards) below and rises 1·02 metres (1·115 yards) above that standard.

From that lock to the next, is 490 metres (535·86 yards) of the same depth; the additional canal is 1108 metres (1211·70 yards) long, the widths at the standard level vary between 13 and 40 metres, (14·21 and 43·74 yards) and the side slopes, which are all puddled and covered with turf, vary between 1 to 1 and 3 to 1.

The outer canal which has been made chiefly by scouring, is 151 metres (165·13 yards) long, to low-water mark, at a depth of 0·47 metres (0·5139 yards); below that point, it is 37·67 metres (41·19 yards) wide, and the sides are constructed of fascines covered with stone.

The principal works enumerated are,—

1st. The sea locks (buiten sluis).

2nd. The interior lock (binnen sluis).

3rd. A bridge of three arches at the sea locks, with balance gates and rising sluices.

4th. A bridge of two arches over the canal in the Noordwykerweg.

The five sea locks are each 19·78 metres (21·63 yards) long and 3·77 metres (4·12 yards) wide; with the mouths of the out-fall culverts 1·88 metres (2·05 yards) below the standard tide level. They are founded upon piles of red and white deal, with sleepers, and the whole faced and covered with deal plank sheathing.

The masonry of the foundations and of the principal part of the construction, is of blue limestone from Escosine, squared and well bedded. A hard stone called "klinkers" is also much used for ashlar work, and an inferior quality of stone for rubble-work, with bricks.

The mortar used up to a short distance above the standard tide level, was made from stone lime, and above that, of lime made from sea-shells; cement was also used in several parts.

The modes of constructing these various works are given in minute detail; many of them, differing materially from the English method of construction, possess great interest; particularly those which relate to the embankments and the fascine work.

A description is then given of the Canal of Oegstgeest, which is a prolongation of the Canal of Katwyk for the purpose of bringing into the latter, the waters from the Lake of Haarlem; as well as a means of carrying off the waters of a portion of Rhynland, during and after the drainage of the lake.

In consequence of the establishment of this canal, the Canal of Katwyk required to be enlarged, which was done to the extent of rendering it 52 metres (56·86 yards) wide, with an average depth of 2·20 metres (2·40 yards) below the standard level. The bridges were also enlarged, and it is now contemplated to add two openings to the inner lock, those of the sea locks being already of sufficient capacity.

Having described the works in detail, the author enters into some general remarks upon the effect produced by the canal, one of the principal being its beneficial use in determining the possibility of draining the Lake of Haarlem. Thirty-five years of experience have demonstrated that this canal is the surest remedy for the peculiar position of the district of Rhynland with regard to drainage; the constant action of the North Sea has made no impression upon the simple but solid masonry of the sea locks; in fact, the Canal of Katwyk appears to be one of the most remarkable hydraulic works ever constructed for the protection of Holland.

The author concludes the paper by stating, that although he could with difficulty spare the time from his professional labours on the Amsterdam railway, of which he is the engineer, he was induced to undertake the labour of drawing up this memoir, by the subject being one of those proposed by the Institution of Civil Engineers, in the list for Telford and Walker Premiums for

1842, and by the desire of doing justice to the memory of his father, whose early decease alone prevented his name from becoming as extensively known as his talents deserved.

The Paper is illustrated by nine comprehensive drawings and charts, with some lithographic views, a portrait of Mr. Conrad, sen., and the medal which was struck on the occasion of the first opening of the sluices.

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"*On the Construction of the Bridges on the Bolton and Preston Railway.*" *By A. J. Adie.*

This Paper, which was written at the request of General Pasley, and by him communicated to the Institution, contains a description of the bridges over the Cowlin Brook, the Lancaster Canal, and the Chorley Road, which alone possess any peculiarities of construction, and they formed the types upon which the other bridges were built.

In Colonel Sir F. Smith's report upon the Cowlin Brook bridge, he advised great attention being paid to the bridge on account of its "unusual slightness, and the badness of the ground upon which it was founded." The author states, that the latter circumstance induced him to design the present proportions of the work as he wished to reduce the weight of the piers as much as possible; he therefore ventured to deviate from the original design given by Mr. Rastrick. The result has justified his anticipations, as "after the most careful inspection not a single crack nor a splintered stone can be detected."

The ground where this bridge was to be placed, was found to be a rotten and compressible mixture of moss, decayed wood, and sand, with a few large stones; a foundation was made for each pier by driving in piles 20 feet long by 12 inches square; upon these were placed the footing courses of Limerick stone 8 inches thick; the piers were built hollow, so that the utmost weight placed upon each superficial foot should not exceed 5½ tons, which the author states to be a light load for ashlar work:—"In Edinburgh there are old rubble walls 34 inches thick and above 100 feet high, which in addition to all their proportion of eight floors, and a roof, have 6¼ tons on each superficial foot of the bottom courses, and there is a brick chimney in Bolton, the bottom courses of which support 8½ tons on the superficial foot."

The bridge consists of eight arches, each of 30 feet span; the arch stones are 18 inches thick, of hard sandstone from the Whittle hills, except seven courses at the crown, which are from a better quarry at Ackrington, near Blackburn.

The author then mentions, as a precedent for such dimensions, some arches constructed under Mr. Jardine's direction on the Edinburgh and Dalkeith Railway; they were of Craigleith stone, semielliptical in form, of 24 feet span, with a rise of 4 feet, or ⅙th of the span; the stones for these arches were 12 inches deep at the springing, and 9 inches deep at the crown; the abutments of one of them are founded on platforms of timber, without piles, resting upon soft plastic blue clay; they have been standing for upwards of ten years, and exhibit no signs of failure. Another arch is also mentioned, constructed by the same engineer, over the South Esk, near Dalkeith, the span of which is 55 feet, and the versed sine 12 feet; the key-stone is 18 inches deep, and the springers 21 inches in depth.

The author objects to placing a mass of earth upon the haunches of the arch, as, from the tremor caused by the passing of the railway trains, the earth has always a tendency to be wedged in between the side walls and to force them out; he therefore left voids above the arch stones, allowing only sufficient weight of masonry upon the haunches, and thus securing the rapid hardening of the mortar; for this latter reason also the walls of rubble-work never much exceed 3 feet in thickness, and they have been found much stronger in consequence.

The railway is carried over this viaduct on longitudinal bearers, 13 inches deep by 6 inches thick, laid on planks 3 inches thick; the bearers and planks are not fixed together, with a view to diminish the vibration of the passing trains; this method of laying is stated to be very effective in this respect.

The Lancaster Canal Bridge was originally intended to have been a direct span of 60 feet, constructed of iron, but the directors subsequently decided on building a skewed stone arch of 25 feet span on the right angle. The arch is semi-elliptical on the square, with a transverse axis of 41 feet 2 inches, and a semi-conjugate axis of 8 feet 9 inches; the arch stones are 2 feet 3 inches on the square at the springing, and 1 foot 6 inches at the key-stone; the bed joints intersect at right angles all the lines of sections of the intrados, made by vertical planes, parallel to the elevation; and it is that property that causes the chamfer lines of the beds of the stones to diverge from the springing to the crown. These lines of the curved joints are easily laid down on the sheeting of the centres from a full-sized development, and by lines drawn at different heights, parallel to the springing of the arch. The lines of the radiating bed joints are always perpendicular to the tangent of an ellipse of the same form as the elevation of the bridge, the moulds used to form

this being applied in the plane of the elevation. The twist on the length of the beds of the courses was taken from full-sized skeleton moulds of the form of the oblique ellipse or elevation. The five courses running parallel to the abutments are all of the same form, and have the same amount of twist on the beds of each stone, except the end stones of the courses, which are varied in length to suit the general breaking of the joints of the courses resting together. The centre part of the arch is plain square work.

This mechanical method of finding the lines, and the twist of the radiating beds for an elliptical skewed arch, is destitute of the scientific accuracy of the mode by which Mr. Buck calculates his spiral lines for oblique bridges, of which the section at right angles to the abutment is an arc of a circle; but the workmen had no difficulty in putting it in practice, and the author states that he would have had more trouble in constructing trussed centres for a flatter curve of a circular arc, and at the same time keeping the towing path of the canal open. He states that he has not met with any description of an arch executed in this manner, but he considers it the only true principle. Every very thin section parallel to the elevation is a proper elliptical arch, and there is a very great saving of stone from the smallness of the twist on the curved beds as compared to the common method of working them.

The Chorley-road Bridge is a compound of the common and skewed arches, which the author finds convenient and economical. He has executed several upon this plan; they are as perfect as the best common arches, and free from skirting of the soffits of the stones. The section of this bridge at right angles shows a rise of 5 feet, with a span of 25 feet. The springers at this part are 15 inches deep, and the key-stone is 13 inches deep; on the oblique section, or the elevation, the span is 37 feet 9 inches, and the rise 5 feet; the springers are 24 inches deep, and the key-stone is 17 inches deep.

The straight part of the arch is formed with courses about 10 inches on the soffit, and these are turned round in curved lines, which are portions of circles, the straight parts of the courses being then tangents, and they cut the lines of the elevations at right angles, so that there is no more tendency of the arch to sink at the elevation, than would be the case with any elliptical segment of similar dimensions worked in the ordinary way. The part of the acute angle of the arch is formed with courses which converge from the elevation to the abutments, on account of being arcs cutting the elevations at right angles, and then becoming nearly tangential at the springing. The curves for these courses were transferred from the development to the sheeting, in the same way as those for the Lancaster Canal Bridge, and the twist of the beds was taken off full-sized sections of the arch, made in the directions of the converging lines of the extremities, so that at each of these places the beds were worked as if for part of a true elliptical arch, and the beds between the points thus formed were worked off with curved rules found from the development. After the masons got into the way of working this kind of arch, they of their own accord preferred it to the complete skewed arch. In brick-work built in this way, it would be very easy to skew the ends of a long archway, by having the bricks moulded to the curvature of the key-course, as with a very little alteration they would fit any part of the concentric courses, and a few tapered bricks would facilitate the filling up of the fan-shaped part of the haunch of the acute angle.

The communication was illustrated by several detailed drawings, and a model of the bridge, with schedules of the prices and cost of the works.

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"*On some peculiar Changes in the Internal Structure of Iron, independent of, and subsequent to, the several processes of its manufacture.*" *By Charles Hood, F. R. A. S., &c.*

The singular and important changes in the structure of iron, which it is the object of this Paper to explain, are those which arise in the conversion of the quality of iron, known by the name of "red short iron," which is tough and fibrous, into the brittle and highly crystallized quality known by the name of "cold short iron." This change the author considers has never been attributed (as it ought to be) to the operation of any definite and ascertained law, but has generally, when observed, been supposed to arise from some accidental cause, and been considered as an isolated fact.

The fracture of railway axles, by which some of the most lamentable accidents have occurred, arises from this molecular change in the structure of iron, by which the axles lose a vast proportion of their strength.

The principal causes which produce this change are percussion, heat, and magnetism, and the author traces through a great number of practical cases of ordinary occurrence the joint, as well as the separate effect of these three causes; showing that the rapidity of the change is proportional to the combined action of these several causes, and that in some cases, where all the three causes are in operation at the same time, the change of

structure is almost instantaneous; while in other cases, where this united operation does not occur, the change is extremely slow, extending over several years before it becomes sensible. Among the examples given, and of which the causes are explained, are the conversion by means of heat, as in the case of wrought-iron furnace-bars, and other analogous cases, particularly when any vapour is present: the operation of the tilt hammer, in the planishing of iron, by which both vibration and magnetism of the bar is produced, when the temperature is within a certain limit, beyond which limit the bar loses its magnetic power, and no crystallization occurs; and the instance of piston-rods and other cases, where, from any accidental circumstance, a peculiar jar or vibration has been given to particular parts. The effect of the continual jar or vibration upon the axles of common road carriages is a case of the opposite kind, where, notwithstanding the continual vibration, this molecular change does not take place *when the axle is insulated from the effects of magnetism.* In railway axles, however, the case is very different. The rapid rotation of the axle produces powerful magnetic action, while the friction causes much heat; and these effects, added to the constant percussion which is produced by the peculiar motion of railway wheels, causes the crystallization to be produced with extreme rapidity; the effect being probably further increased in the axles of locomotive engines by the magnetising power of the electricity generated by the effluent steam. The crystallized structure being the natural condition of iron, as well as of several other metals, the author considers that in these changes we observe a constant effort to return from the artificial to the natural and primal condition of the metal, and the conclusion arrived at is, that this crystallization is not necessarily dependent upon time for its development, but is determined by other circumstances, of which the principal is undoubtedly vibration: that heat, although it assists, is not essential to it, but that magnetism, whether induced by percussion or otherwise, is an essential accompaniment of the phenomena. The paper concludes by pointing out the increased effects likely to result from the rigidity of the springs, the looseness of the brasses, and other causes which increase the vibration on the axles of railway carriages.

Several samples of broken railway axles were exhibited; some of them being cut from different parts of the same axles, showed that at the journals, where the vibration was the most intense, the crystallization was increased to a great extent beyond what occurred in other parts of the same axle.

Mr. Moreland had frequently noticed that pins for chains, and pump-rods, although made of the best iron, would, if subjected to concussion, after a certain time break suddenly, and that the fracture would exhibit a large crystallized texture. This was also frequently observed in the broken axles of road-carriages, although they were generally made of iron of the finest quality.

Mr. E. Woods had observed the crystallized fracture in all the broken axles on railways which he had seen.

Mr. Hood exhibited some specimens of broken axles, all of which showed a large crystallized fracture; he believed that the iron from which the majority of them had been made was of the best quality, and in the parts not immediately subjected to concussion the fracture was quite different. One of them had been in use only three months, and had become so brittle that, on attempting to break it, it jarred off the shoulder of the journal, although an incision was made all round at the spot where it was intended to be broken.

Mr. York would account for the tendency of the axles to break at the journal, by that part being subjected during the process of forging to more hammering than the body.

Mr. Hood agreed that such might be the case, but he conceived that it was more probably produced by cold hammering. He had taken a sample from the body of a broken cranked axle, from the Grand Junction Railway, the iron of which was evidently of the best quality, but at the point of fracture, which was certainly at that part where it had been most hammered, the fracture presented a large crystallized texture.

A large anchor, which had been in store for more than a century at Woolwich Dockyard, and was supposed to be made of extremely good iron, had been recently tested as an experiment, and had broken instantly with a comparatively small strain; the fracture presented very large crystals: in this case he believed the length of time which the anchor had remained in the same position had produced the same effects as magnetism and vibration.

Mr. Lowe stated that at the gas-works under his direction wrought-iron fire-bars, although more expensive, were generally preferred; a pan of water was kept beneath them, the steam from which would speedily cause them to become magnetic: he had frequently seen these bars, when thrown down, break into three pieces with a large crystallized fracture.

Mr. Miller had frequently seen in manufactories, that when the smiths had forged parts of engine-work which from their in-

tricate forms had required to be much hammered, the ends were jarred off while they were being worked upon. He instanced particularly the side rods of the engine for the 'Lord Melville' steamer, of which, while shutting up the middle, one of the ends of each rod was jarred off, and presented large crystals in the fracture; being well assured of the good quality of the iron in the rods, he had the same welded on again, and although the circumstance had occurred twenty years since, they were still at work, and had not shown any symptom of weakness. It must be evident that in this case, the fracture and the crystallized appearance of the metal must have been produced by the cold hammering to which it had been subjected.

Mr. York agreed with Mr. Hood in the fact of a change taking place in the texture of the iron, but he was of opinion that it more frequently occurred during than after manipulation; he alluded more particularly to railway axles, in which he believed the injury to be done by the cold hammering or planishing after they were faggoted; he had frequently seen one end of an axle fall off while the other was being hammered: in all such cases, and in those of accidental breakage, such as recently occurred on the Versailles Railway, and in other places, the fracture always presented a crystallized appearance.

He then exhibited and described a railway axle, which he stated to possess the combined advantages of rigidity and toughness, and avoiding entirely the crystallization of the iron during the process of manufacture; this he described to be effected by maintaining the axle in a hollow state during the whole operation of hammering, thereby avoiding the vibration and concussion, to which cause he attributed the crystallization of the iron in solid axles, being of opinion that the repeated blows of the hammer on a solid mass, particularly during the process of "planishing," were the chief, if not the only cause of the ductile quality of the iron being destroyed. He stated, that he had made numerous experiments for the purpose of ascertaining this fact, and in every instance when the axle was sound, the iron presented the same crystallized fracture, although the bars, previous to their being welded together, were of the most fibrous quality; but if the axle was not quite sound, and the bars not perfectly welded to the centre, then the fracture was somewhat fibrous, the axle being partially hollow and thereby avoiding the vibration to a considerable extent. This fact suggested to him the propriety of keeping the axle hollow; and the mode of manufacture he described to be by taking two dished half-cylindrical bars of iron, of the entire length of the axle, putting them together and welding them under a hammer in swages, by which means the particles are not driven asunder by the heavy blows and the axle or faggot lengthened, but are driven together and towards the centre. The axles produced by this means, he stated to be as perfectly ductile as the bars in the first instance. A further advantage, he stated to consist, in being able to make half the whole length of the axle at one heat, thereby avoiding to a considerable extent the danger of burning the iron by repeatedly heating it; the iron in the axle he described, as being an uniform cylinder in thickness, and consequently requiring an uniform heat, whereas the external bars of a faggot for a common axle were liable to be burnt, before the centre was heated to a welding state. The diameter of the hollow axle was increased from 3½ inches (the general size of a solid axle) to 4 inches in order to give a proper degree of rigidity, but without increasing the weight.

The usual proof to which solid railway axles were subjected, was by allowing a weight of 6 cwt. to fall upon them from a height of 9 feet; with that force they were frequently broken at the second blow, and sometimes by the first—he had tried some of the hollow axles, by letting fall upon them a weight of 10 cwt. from a height of 15 feet, without breaking one of them.

## ABSTRACTS OF SPECIFICATIONS OF ENGLISH PATENTS RECENTLY ENROLLED.

REUBEN PARTRIDGE, OF COWPER-STREET, FINSBURY, IN THE COUNTY OF MIDDLESEX, ENGINEER, *for certain improvements in machinery or apparatus for splitting and shaping wood into splints for the manufacture of matches, and other similar forms.* Rolls Chapel Office, September 7, 1842.

These improvements in machinery or apparatus for splitting and shaping wood into splints for the manufacture of matches, and other similar forms, consist in the employment of a perforated metal plate, through which blocks of wood are to be passed by means of pressure, the perforations in such plate being so shaped and situate as to cause the block of wood, when pressed against its face, to be divided or split into a multitude of small rods or splints, and these splints protruded through the perforations of the plate in regular-formed rods, either of a cylindrical, square, polygonal, or other figure, according to the shapes and dimensions of the perforations in the plate.

The forms of the perforations are to be cylindrical throughout, except at their open-

ings on the face, where they are to be slightly countersunk, for the purpose of presenting sharp-cutting edges to the wood, when pressed upon it, and in order to afford more easy entrance.

The size of the perforations must depend upon that of the required splints or matches to be produced; but the patentee directs that they must be as close together as possible, allowing sufficient substance of metal to afford strength and resistance to the pressure when the wood is forced through. And the reason why the apertures must be so closely contiguous is, that there may be as small a space of surface or blank between the holes as possible, in order that resistance to the passage of the wood may be avoided, and that the whole area of the block of wood may be compressed laterally into the countersunk openings, and forced through the cylindrical perforations.

A drawing of a plate constructed according to the preceding conditions accompanies the specification. The face is here represented as being of steel, with a bell-metal back, and as about three inches wide by six inches long, and nearly an inch thick.

The mode of operation which has been found to answer best is stated to be—by fixing the back of the plate against a firm resisting block or bearing, having an aperture equal to the area of the perforations in the plate, and then placing the end of the piece or pieces of wood, in the direction of the grain, against the face of the plate, within the area of the perforated parts. A plunger, or a lever, or any other suitable mechanical agent, being then applied to the back, or reversed end of the piece of wood, it may be forced through the perforations in the plate, being first split as it advances by the cutting edges of the holes, and afterwards compressed and driven through the perforations in the plate, coming out on the opposite side, or back of the plate, in the form of a multitude of distinct splints, according to the shapes and dimensions of the perforations.

Sir James Murray, of Merrion-square, Dublin, Knight and Doctor of Medicine, *for an improved method of combining various materials, in a manner not hitherto in use, for the purpose of manure.* Specification of Scotch Patent. Enrolled September 12, 1842.

The main object of this invention or improvement is stated to be, to produce a compound such, that when mixed in, by ploughing, harrowing, raking, digging, or otherwise, with soil, earth, mould, or any ordinary compost, it shall cause to be generated or evolved within the soil itself carbonic acid and useful salts, so as to augment the supply of nutriment for vegetables, and improve the quality of crops generally. This object Sir James Murray proposes to effect, by drying up and mechanically fixing and solidifying the common mineral acids, which in their ordinary state, as articles of sale, are not well adapted for purposes of manure, and also phosphoric acid, by mixing them with dry, porous, and absorbent matters, vegetable, animal, or mineral, such as bran, sawdust, dust of malt, husks of seeds, ground rags, pulverized rape or linseed cakes, the refuse of flax, leaves, bark, dry tan, siliceous sands, peat or other sandy mould, dry dust, earth or clay, fine sifted cinders, ashes, charcoal, and the like, in which form they may be more conveniently and advantageously combined with alkaline substances, and so combined may be worked into the ground in a dry state; the chemical action by which the carbonic acid is evolved, and the salts generated, taking place subsequently, and in the most advantageous manner, in the soil itself, when excited by the moisture then present in it, or which may afterwards fall upon it in rain or dew. For obtaining this powdery acid compound, the acids which the patentee finds most suitable are, 1. The phosphoric acid; 2. The nitric or nitrous; 3. The hydro-chloric, or muriatic; 4. The sulphuric. And he uses the following processes, whereby different compounds are produced, but all with this common property, that they are acids fixed in a solid state by mechanical mixture, with an absorption into porous or powdery matter.

"Firstly, I mix any suitable quantity of the mineral called apatite, or asparagus-stone, or native phosphate or phosphorite of lime, or fossil bone earth, with an equal weight of common, or cheapest sulphuric acid, or any other of the above-mentioned acids. This paste or mixture is well agitated in an earthen vessel, two or three days, and is then intimately incorporated with one, two, or more of the absorbent substances above enumerated, in sufficient quantity to convert this acidulous phosphoric mixture into compost, which I call "phosphoric compound or powder." In this process, although I specify the phosphoric acid and the superphosphate of lime thus produced from the mineral phosphate of lime or apatite, which phosphoric acid and phosphate are well adapted for my compound, and are now first applied by me to such purpose, yet I do not restrict the process to the use of this mineral phosphate, inasmuch as any phosphoric acid and super-phosphate of lime, however obtained, will equally answer the purpose."

"Secondly, I mix any suitable quantity of nitric or nitrous acid with such a quantity of one or more of the absorbent substances

already mentioned as is found sufficient to incorporate the centre mixture into a dry or powdery compost. This compound, when intended to be used for manure, I again mix intimately with an equal weight of powdered alabaster or sulphate of lime, whereby the acid fumes are more confined and held in, and the manuring properties are aided, when these various substances are well and thoroughly incorporated, by stirring and mixing them upon a suitable floor, or in proper vessels; the dry mixture so obtained is put into casks or earthen jars, from which the air is carefully excluded. This compound, which I call "acidulous nitric powder," is well adapted for producing carbonic acid and the useful class of nitrates within soils, when introduced together with alkaline or earthy carbonates, in the manner hereafter shown."

"Thirdly, I mix or rake any suitable quantity of hydrochloric or muriatic acid with such a quantity of one or more of the already mentioned porous substances as is found sufficient for incorporating it into a dry or powdery compound. For agricultural purposes, I add to this an equal weight of powdered alabaster, and intimately mix the whole together: the resulting mixture is then put in casks or stone vessels, and secured from the air, and to this compound I have given the name of "acidulous muriatic powder."

"Fourthly, I mix any suitable quantity of sulphuric acid with such quantity of one or more of the most appropriate of the absorbent substances already mentioned as is sufficient to form a dry powdery compost, as before. To this, when intended for agricultural purposes, I add an equal weight of dry and powdered acidulous sulphate of soda, and the same weight of dry and pulverized acidulous sulphate of potass. These, when well mixed and incorporated together, form another compound, which is put into casks or vessels, and called by me "acidulous vitriolated powder."

Each of the acids above mentioned the patentee finds to require for mixture nearly half its weight of one or more of the light absorbent porous substances above mentioned; more, however, should be added when necessary to secure a perfectly dry and pulverizable combination. Any one or more of the acidulous powdery compounds may be used, either together or separate, in carrying out the principal object of the invention, as explained in the commencement. And in making the selection, regard must be had to the nature and quality of the lands to which the compost is to be applied, and the kind of crops proposed to be obtained. Thus, phosphates, nitrates, muriates, or sulphates, all or any, as may be desired or found advantageous, may be generated within the soils by the chemical union of the several acid powdery compounds, respectively, with a sufficient quantity of alkaline matter, either already existing in the ground, or artificially introduced into it for the purpose. But, speaking generally, the patentee says that he finds it peculiarly advantageous to conjoin two or more of the before-mentioned acid compounds, or all of them together, taking equal quantities of each into one general mixture, which he calls his "consolidated acid compound," and which combination, whether of all or of any two or more, constitutes a fifth species of acid compound.

The patentee proceeds to specify the alkaline substances with which, for the purposes of manure, the acid compounds are to be mixed.

"The substances which may be beneficially employed for this purpose are supercarbonates, carbonates, and even subcarbonates of soda, potass and ammonia, and also earthy carbonates of lime, as limestone, marble, chalk, calcareous marl, coal, coraline or shells, or the carbonate of lime, remaining after the purification of coal gas, and also magnesian carbonate, such as the mineral called dolomite, or any of them. In order to secure abundance and variety of alkaline matter, (for as the saline constituents of plants are very numerous, a variety of alkalies as well as of acids is beneficial,) the method which I use is the following:—I take 1 cwt. powdered sesqui-carbonate of ammonia, 1 cwt. sesqui-carbonate or bi-carbonate of soda, 1 cwt. powdered dolomite, 1 cwt. carbonate of lime or coral or coraline, and 1 cwt. bi-carbonate of potass. All these I mix well with 1 cwt. of silicate of potass or soda. The powder so obtained, I call my alkaline mixture, but I do not claim either the ingredients or the combination as any part of my invention. I only state and describe it as part of the process whereby the general result is effected. For obtaining the silicate, I mix 7 parts of powdered hornblende, trap, or felspar, with 3 parts of black soda ash obtained from salt, or with 20 parts of kelp, and fuse them together for four hours in a furnace or kiln. The alkaline mixture, so obtained, I mix in equal quantities with either or any of the four acidulous powders, or with the consolidated acid compounded severally above described. This resulting mixture I call my fertilizing compost or powder: and I claim it as another and distinct part of my invention. The fertilizing compost is to be put up in casks, and kept dry till used. It is to be ploughed, harrowed, or raked into mould or soils, and it may be introduced into

subsoils to improve their quality, or may be mingled with clay, earth, or other compost heaps, or pits for manure. Another highly beneficial mode of using it is the following. By being briskly agitated or rolled in strong casks, with twenty times its bulk of water or stable liquids, it will impregnate such fluids with fixed air, which may then be applied by irrigation, sprinkling, or arrosion, to the fertilizing of lands, pastures, meadows, or gardens, and the attracting or fixing of ammonia."

*Claim.*—"I do not claim to have discovered any of the above-named mineral acids or alkaline ingredients. But I claim as one part of my invention the acid powdery compound (five several kinds of which I have above numerated and described) whereby the hitherto liquid acids are rendered solid and portable, and thereby capable of being brought advantageously and conveniently into combination with alkalies and alkaline earths. And I also claim as a further part of my invention the combination of the acid *powdery* compound with an alkaline mixture, and the compost or manure thence resulting. And as I am aware that other combinations of acids and alkalies may be used, differing in some degree both as to the ingredients and the proportions from those herein described, but capable of producing similar effects, I do not restrict my invention or any part of it to the particular mineral acids, or the particular alkaline substances before enumerated, or the exact number or proportion of the specified ingredients; but I claim as my invention, the compounds resulting from the mixture of a mineral acid with a porous powdery substance, so as to mechanically solidify the acid, or acids, or absorb it, or them into the powder, and also the combination of such compound with alkaline or earthy carbonates for the evolving carbonic acid within the soil, and about the roots of vegetables, and for generating salts upon and within the ground itself, instead of spreading such salts in crystals, or powder over the surfacee of land as heretofore."

WILLIAM NEWTON, OF CHANCERY LANE, IN THE COUNTY OF MIDDLESEX, CIVIL ENGINEER, *for an improved machine or apparatus for weighing various kinds of articles or goods; being a communication from a foreigner residing abroad.* Rolls Chapel Office, August 22, 1842.

The present patent is for certain improvements upon a machine or apparatus for weighing, for which a former patent was granted on behalf of the same foreigner, and dated September 19, 1839.

The principal features of the former invention may be briefly described as follows: The scale or plate in or upon which the goods or things to be weighed were placed, were suspended by a chain or cord, attached to and passed over or round a pulley. This pulley was mounted upon and firmly fixed to an axle, formed at its two extremities like wedges, or knife edges on which it rocked or oscillated. This pulley had also at its lower side a pendant arm, or lever, to the extremity of which an adjustible weight was attached, which, when raised, described the segment of a circle as the pulley was drawn round on its axis by the weight of the goods placed in the scale. To the same axle as the pulley just described was affixed the needle or index, which, as the axle turned, pointed out on a graduated quadrant, indicator, or face-plate, the weight of any body placed in the scale. The graduations or divisions on the indicator gradually increased from the point zero, and the method of correctly setting off these divisions or graduations was fully explained.

In the machine as now improved, instead of suspending the scale by means of a cord or chain passed over a pulley as in the former invention, the pulley is entirely suppressed and a curved lever substituted in its place, which curved lever is formed on or connected to a collar, through which the axle or shaft passes and is firmly fixed thereto by a tenon and screw nuts. The pendant or vibrating weight, which, in the former construction was connected to the pulley, is now entirely distinct from it, or rather from the curved lever used in place thereof, and is connected to a rod or lever, the upper end of which is terminated by a collar similar to the collar of the curved lever, and is fastened to the axle in like manner. The needle or index is also connected to the axle in a similar manner and vibrates on the centre thereof in front of the index plate, on which the needle points out the exact weight of any body that is placed in the scale. The graduations of the indicator in the old machine increased in size the farther they receded from the zero point, but in the present construction, the divisions are made to diminish the farther they recede from the zero point.

## LIST OF ENGLISH PATENTS GRANTED BETWEEN THE 31ST OF AUGUST, 1842, AND THE 22ND OF SEPTEMBER, 1842.

Charles Frederick Guitard, of Birchin-lane, notary public, for certain improvements in the construction of railways. August 31; six months.

Charles Thatcher, of Midsomer Norton, Somerset, brewer, and Thomas Thatcher, of Kilmersdon, in the said county, builder, for certain improvements in drags or breaks to be applied to the wheels of carriages generally. August 31; six months.

Robert Hazard, of Clifton, near Bristol, for improvements in ventilating carriages and cabins of steam-boats. September 3; six months.

William Roche, of Prince's-end, Stafford, mechanic and engineer, for improvements in the manufacture of mineral colours. September 3; six months.

William Warburton, of Oxford-street, gentleman, for improvements in the construction of carriages and apparatus for retarding the progress of the same. September 8; six months.

John Wordsworth Robson, of Jamaica-terrace, Commercial-road, engineer, for certain improvements in machinery and apparatus for raising, forcing, conveying, and drawing off liquids. September 8; six months.

James Insole, of Birmingham, saddlers' ironmonger, for improvements in the manufacture of brushes. September 8; six months.

Joseph Henry Tuck, of Francis-place, New North-road, engineer, for certain improvements in machinery or apparatus for making or manufacturing candles. September 8; six months.

William Edward Newton, of Chancery-lane, civil engineer, for improvements in machinery or apparatus for making or manufacturing screws, screw-blanks, and rivets. (Being a communication.) September 8; six months.

Herbert George James, of Great Tower-street, merchant, for certain improvements in machines or apparatus for weighing various kinds of articles or goods. (Being a communication from abroad.) September 8; six months.

William Fothergill Cooke, of Copthall-buildings, Esq., for improvements in apparatus for transmitting electricity between distant places, which improvements can be applied, amongst other purposes, to apparatus for giving signals and sounding alarums at distant places by means of electric currents. September 8; six months.

Thomas Thirlwall, of Low Felling, Durham, engine-builder, for certain improvements in lubricating the piston-rods of steam-engines, and of other machinery. September 8; six months.

William Crofts, of New Radford, Nottingham, lace machine maker, for improvements in the manufacture of figured or ornamental lace. September 8; six months.

Thomas Marsden, of Salford, Lancaster, machine maker, and Solomon Robinson of the same place, flax-dresser, for improvements in machinery for dressing or hackling flax and hemp. September 8; six months.

James Wake, jun., of Goole, York, coal-factor, for certain improvements in propelling vessels. September 9; six months.

John Rolt, of Great Cumberland-place, colonel in Her Majesty's army, for certain improvements in saddles. September 15; six months.

Frederick Bowles, of Moorgate-street, London, for a new method, by machinery of preparing flour from all kinds of grain and potatoes, for making starch, bread, biscuits, and pastry. (Being a communication from abroad.) September 15; 6 months.

Christopher Nickels, of York-road, Lambeth, gentleman, and Caleb Bedells, of Leicester, manufacturer, for improvements in fabrics produced by lace machinery. September 15; 6 months.

William Henry James, of Martin's-lane, London, civil engineer, for certain improvements in railways and carriage-ways, railway and other carriages, and in the mode of propelling the said carriages, parts of which improvements are applicable to the reduction of friction in other machines. September 16; 6 months.

John Sanders, William Williams, Samuel Lawrence Taylor, and William Armstrong, all of Bedford, agricultural implement makers, and Evan William David, of Cardiff, for improvements in machinery for ploughing, harrowing, and raking land, and for cutting food for animals. September 22; 6 months.

Patrick Stead, of Halesworth, Suffolk, maltster, for improvements in the manufacture of malt. September 22; 6 months.

John Juckes, of Putney, gentleman, for improvements in furnaces. September 22; 6 months.

### NOTES AND NOTICES.

*Preservation of Life at Sea.*—A letter has been addressed to Lloyd's, from Mr. Edward Jennings, Lieutenant R.N., suggesting the general adoption, in rough weather, of life lines being led fore and aft, both to windward and leeward, so that the men have something to lay hold of in passing from one end of the vessel to the other. In addition to this, he advises that each man be furnished with a belt made gasket fashion, about a fathom and a half long. The utility of this is shown by the wearer, when in an exposed situation, such as on the forecastle, conning, steering, &c., taking two half hitches with it, to either the life line or any of the standing rigging, &c. He observes that such a belt could not interfere with the wearer's duty aloft, as at such times the end might be wound round the body and tucked in. He concludes by impressing the necessity of each captain of merchant vessels being supplied with a good barometer, as a great deal of wear and tear of spars and canvass might be avoided, and the loss of shipping also prevented.

*New Cheveaux-de frise.*—M. de Grange, an engineer at Lyons, has invented a machine of this description, which is composed of a globe of brass of three or four inches in diameter, fixed to an iron handle the thickness of a finger, and about three and a half feet long, with a spike at the end. The globe or ball is perforated with twelve holes, so arranged as to admit of as many lances of the same length as the handle. These lances are fixed in the globe by means of iron pins, and when set up, form a defence of about seven feet in height and as many in length. A body of infantry arriving on a plain furnished with these cheveaux-de-frise, to the extent of double the line it is to form, that is to say, sufficient to cover its front and rear, in the proportion of one for every seven men, one of whom carries the ball and its handle, and each of the six others two lances, can, says the inventor, form itself in order of battle, and on the approach of an enemy's cavalry plant the cheveaux-de-frise in its front and rear to keep them off, and thus the first and third ranks will be enabled to fire in line without the loss of time and frontage occasioned by forming the troops into a hollow or a solid square.

*The Clock at Strasburg.*—After four years' labour the repairs of the astronomical clock at Strasburg are completed. In this curious piece of mechanism the revolutions of the sun, the moon, and the planets are marked down with scientific exactness. Seven figures represent the seven days of the week, each appearing in its turn on the day allotted to it. The four ages come forward to strike the quarters, and the skeleton Death strikes the hours. At noon the Twelve Apostles advance in succession to bend down before the figure of our Saviour, who gives them the benediction. At the same moment a cock claps his wings and crows three times. It is said to be one of the most curious pieces of clock-work in Europe.



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# Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

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## BIRAM'S IMPROVEMENTS IN THE CONSTRUCTION AND APPLICATION OF ROTARY ENGINES.

Fig. 1.

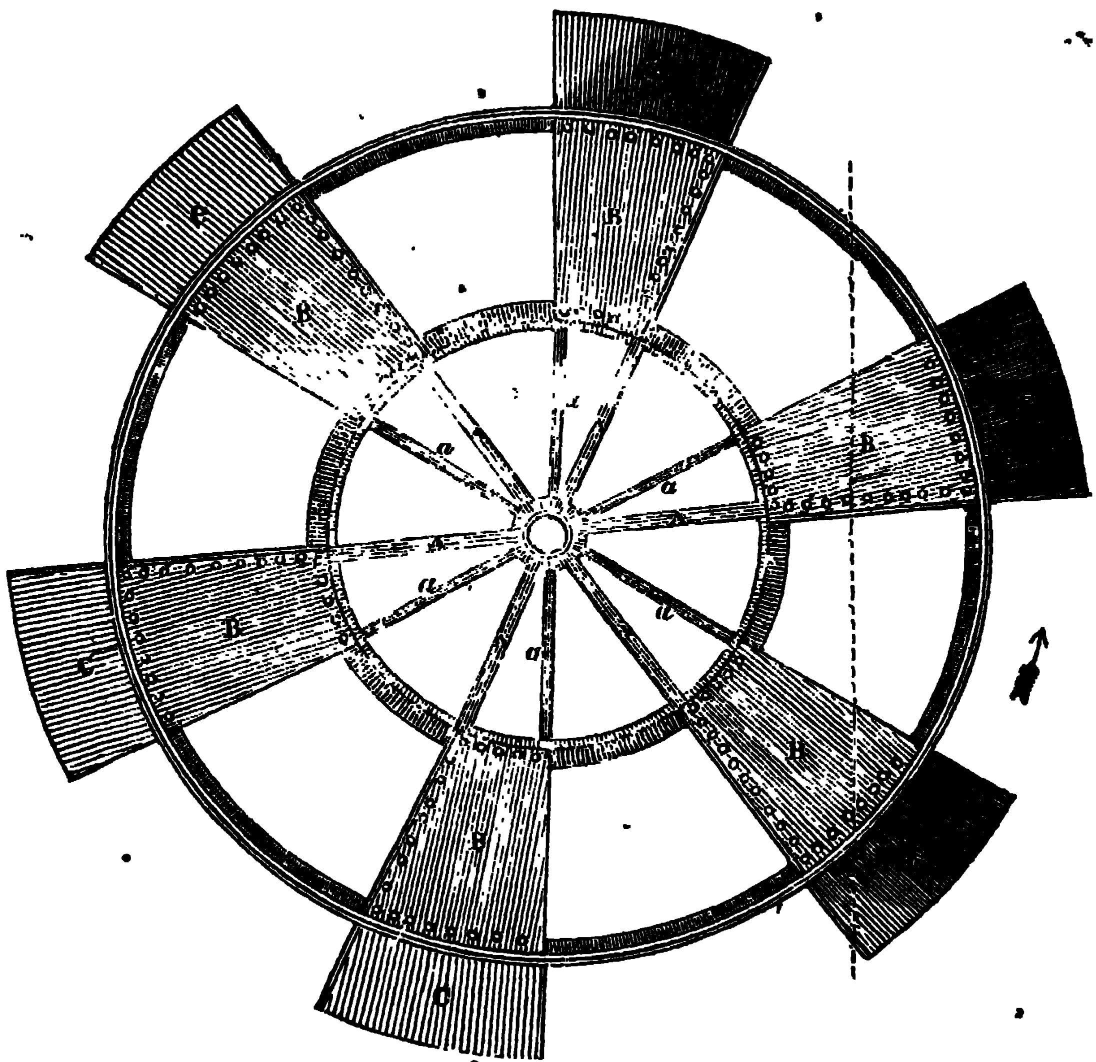
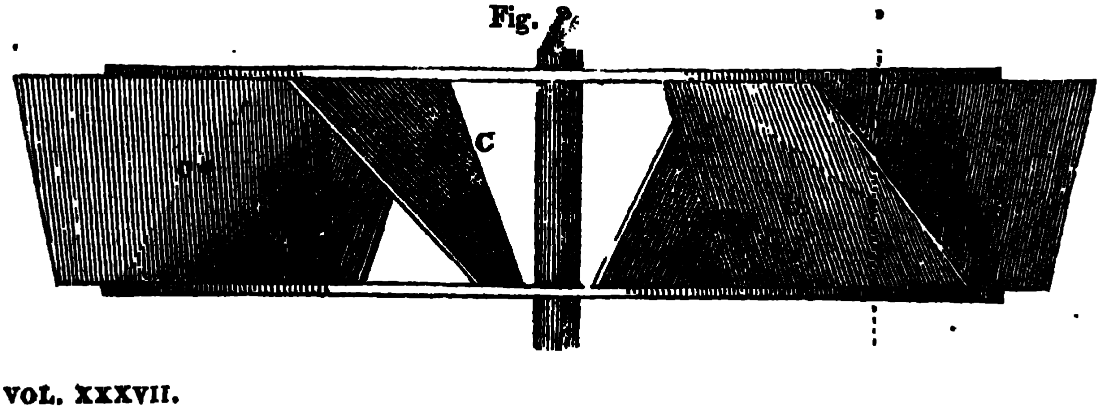



Fig. 2.



## BIRAM'S IMPROVEMENTS IN THE CONSTRUCTION AND APPLICATION OF ROTARY ENGINES.

The improvements which we have now to bring under the notice of our readers form the subject of a patent granted the 8th of February last to Benjamin Biram, Esq., of Wentworth. In his specification the patentee first developes the principles on which his improvements are founded, and then exemplifies their practical application to windmills, paddle-wheels, &c. The former can hardly be called new to mechanical science; but, if we may judge from the novelty of the conclusions which Mr. Biram deduces from them, and which we believe to be perfectly sound, they have never before been so thoroughly understood or well explained.

The vanes of windmills, and other similar machines propelled by currents of air, consist commonly of plain surfaces set *obliquely to the planes of motion* of the machines, but set at angles, as Mr. Biram truly observes, generally determined by guess, and often exceedingly inappropriate; while the floats of water-wheels, and other similar machines acted upon by water, consist also commonly of plain surfaces, but placed *directly in the line of motion* of the fluid. Now, the first position or principle which Mr. Biram undertakes to demonstrate is, that in both these cases there is a certain curved form which may be given to the vanes or floats, or other similar agents, of both those classes of machines, or, in other words, a certain gradual reduction in the angle of obliquity, in proportion to the distance from their axes, by which, in most cases, a greater amount of useful effect can be obtained from them, than by or from any other.

"For example, let A B C of fig. 4 of the accompanying engravings represent the sixth part of a circle described by the revolution of a windmill, in which case the chord C B of the arc A B will be equal to the radius A C, and let the lines A C and C B be divided into six equal parts, 1, 2, 3, 4, 5, 6, so that the chord of the arc at each of the divisions, 5 5, 4 4, 3 3, 2 2, and 1 1, shall be respectively equal to the distances C 5, C 4, C 3, C 2, and C 1; then, to ascertain the angle which a vane or sail should make with the plane of motion, at any other distance from the axis C, (the angle at the extremity on any other point being given,) let the vertical section, fig. 5, be constructed, in which the line A B is equal to the radius A C, or chord C B of fig. 1, and divide it also into six equal parts, 1, 2, 3, 4, 5, 6. Then draw a perpendicular, C 6, of an indeterminate length, and set off the given angle C A B, if it be that of the extremity, or C 3 B if of the middle of the sail, and continue the line until it intersects the perpendicular, C 6. The distance from this point of intersection, C to 6, gives the depth of the cylinder, or space in which the sails may be said to revolve, that is to say, if viewed edgewise, and supposing the wheel to have six vanes, and to be so made as to intercept the whole cylinder of wind. If the depth of the cylinder be required of a different proportion, or if the size of each vane be other than the sixth part of a circle, a line drawn parallel to A B, through such proportionate length of C B, will give the depth of the cylinder required. Then draw the oblique straight lines, C 1, C 2, C 3, C 4, and C 5, from the point of intersection, C, found as above described, and the angles C 1 B, C 2 B, C 3 B, C 4 B, and C 5 B, will be those which the sail should form with the plane of motion, at the distances 1 B, 2 B, 3 B, 4 B, 5 B, from the centre point, B, (fig. 5,) representing the axle or centre of the sails. For, supposing the angle C A B, fig. 2, to be equal to the angle of the sail with the plane of motion at the extremity, or A B, fig. 4, and the wind in the direction D 3, it will strike the sail at the extremity A B, fig. 4, at the angle A C B, fig. 5, which will recede, from the impulse of the wind, in the same time as the points 5 5, 4 4, 3 3, 2 2, and 1 1, at the corresponding angles, C 1 B, C 2 B, C 3 B, C 4 B, and C 5 B, which, (assuming the machine to be unloaded, and without friction,) will be in the same time that the wind passes through the distance C B, fig. 5; whereby it is evident each portion of the sail will present no more than its proportionate resistance to the wind, and recede from its action with that velocity, exactly, which offers the least interruption to the wind's onward progress."

The influence which the angle of inclination exercises on the velocity of the body moved is still more strikingly illustrated by supposing water, instead of air, to be the medium in which it revolves.

"Let A B C D, fig. 6, represent a parallelogram equal to the circumference of a cylinder or wheel, W, fig. 7, formed by the revolution of the sails, and the oblique straight lines C 1, C 2, C 3, and C 4, different angles which the extremities of the sails

make with the plane of motion, as $14^\circ$, $26\frac{3}{5}^\circ$, $45^\circ$, and $56\frac{1}{3}^\circ$. Now, supposing the sails to be placed at the angle C 4 = $14^\circ$, the wheel will make one revolution in the distance D E, which is but one-fourth of its own circumference; while, if they are placed at the angle C 3 = $26\frac{3}{5}^\circ$, it will take from D to F, or twice the distance; and if at the angle C 2 = $45^\circ$, it will take from D to G, or four times the distance, to perform one revolution. Or, to express these results in measures of time, a wheel with the sails at the

Fig. 4.

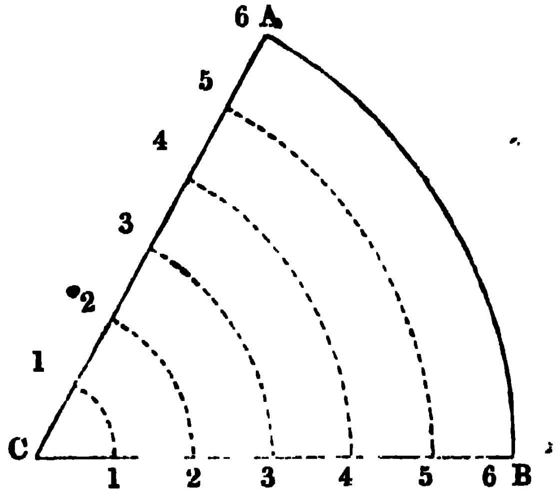



Fig. 5.

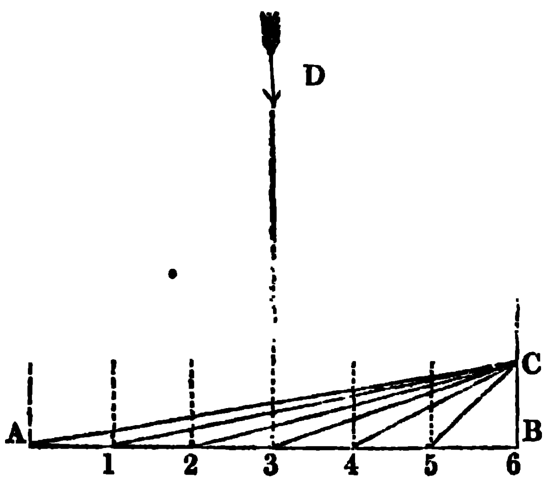



Fig. 6.

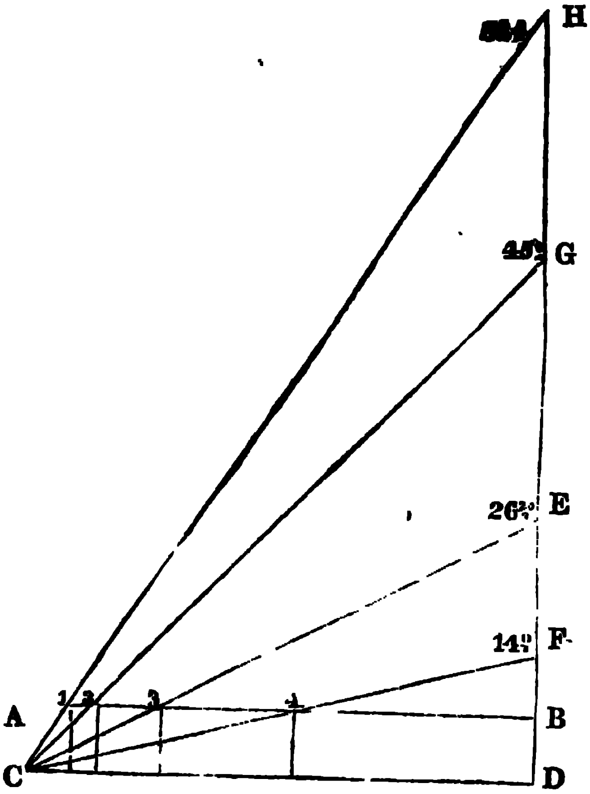
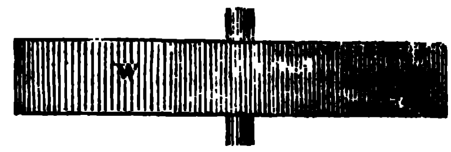



Fig. 7.



angle of C 4 = 14 will make four revolutions in the same time that it performs two revolutions with the sails at an angle of $26\frac{3}{5}^\circ$, or one revolution with them at an angle of $45^\circ$. And if the angle be greater than $45^\circ$, as C 1 = $56\frac{1}{3}^\circ$, the rotation of the wheel upon its axis will be slower than the advance in a lateral direction; that is to say, it will make but one revolution while advancing one and a half times the distance of its own circumference. It will be evident, however, that if the angle of the wheel be at C 4 equal to $14^\circ$, the quantity of water which must pass through it to cause one revolution of the wheel will be equal to the contents of a cylinder of the wheel's diameter and the depth E D; and that if the angle of the vane bear the direction C 3, then double the quantity of water will be required to produce one revolution. Again, if the wheel were to have double the number of floats, (which it ought to have, in order that the water may act upon the whole area of the cylinder or wheel,) then it may be inferred that double the power will be

exerted, but at only half the velocity; so that the angles which would give the greatest maximum result appear to have a much wider range than with sails of the ordinary construction, or than has generally been supposed."

The difference between the vanes of a windmill when set at the angles hitherto most commonly observed, and set at the progressively decreasing angles determined by the method before pointed out and recommended, or so curved as to present these progressively decreasing angles, is shown in the following tabular view. The radius is supposed to be divided, as before, into six equal parts, and the sail is supposed to form, at its extremity, an angle of 7° with the plane of motion.

| | | | | | | |
|---|---|---|---|---|---|---|
| Weather angles, at each of the six points .. | 1 | 2 | 3 | 4 | 5 | 6 |
| Ditto, according to the common plan .... | 18° | 19° | 18° | 16° | 12½° | 7° |
| Ditto, according to Mr. Biram's plan .... | 37½° | 20½° | 14° | 10½° | 8½° | 7° |
| | | | Middle. | | | Extremity. |

A convenient method of ascertaining the proper angles to be given to vanes or floats, at any required distance from the centre, when the angle at any one distance has been given, is shown by the diagram, fig. 8.

"The line B C represents the centre line of the wheel; D E, the circumference; *a*, *b*, *c*, *d*, *e*, and *f*, radial lines, drawn at distances, in respect to each other, corresponding with the angles to the centre of 14° 2′, 26° 14′, 45°, 56° 19′, and 63° 26′, as represented by the oblique lines C *b*, C *c*, C *d*, C *e*, C *f*; *g*, *h*, *i*, *k*, *l*, *m*, *n*, *o*, *p*, *q*, *r*, *s*, *t*, *u*, other oblique lines, representing the various angles to the centre marked thereon; and 1, 2, 3, 4, 5, vertical lines parallel with the centre line, intersecting at equal distances the different radial and oblique lines. Now, the angle which any vane, with a given terminal angle, should have, at any point nearer to the centre, as 5, 4, 3, 2, or 1, will be the same as that of the oblique line, which is intersected at that point by one or other of the vertical lines, 5, 4, 3, 2, or 1. For example: a vane whose extremity is at an angle of 45°, if constructed according to the diagram, fig. 8, will present, at the distances from the centre of the wheel stated below, the angles set opposite thereto:—

| | |
|---|---|
| At one-sixth, an angle of .... | 80° 32′ |
| At two-sixths „ .... | 71° 34′ |
| At three-sixths, or middle..., | 63° 26′ |
| At four-sixths „ .... | 56° 19′ |
| At five-sixths „ .... | 50° 11′ |

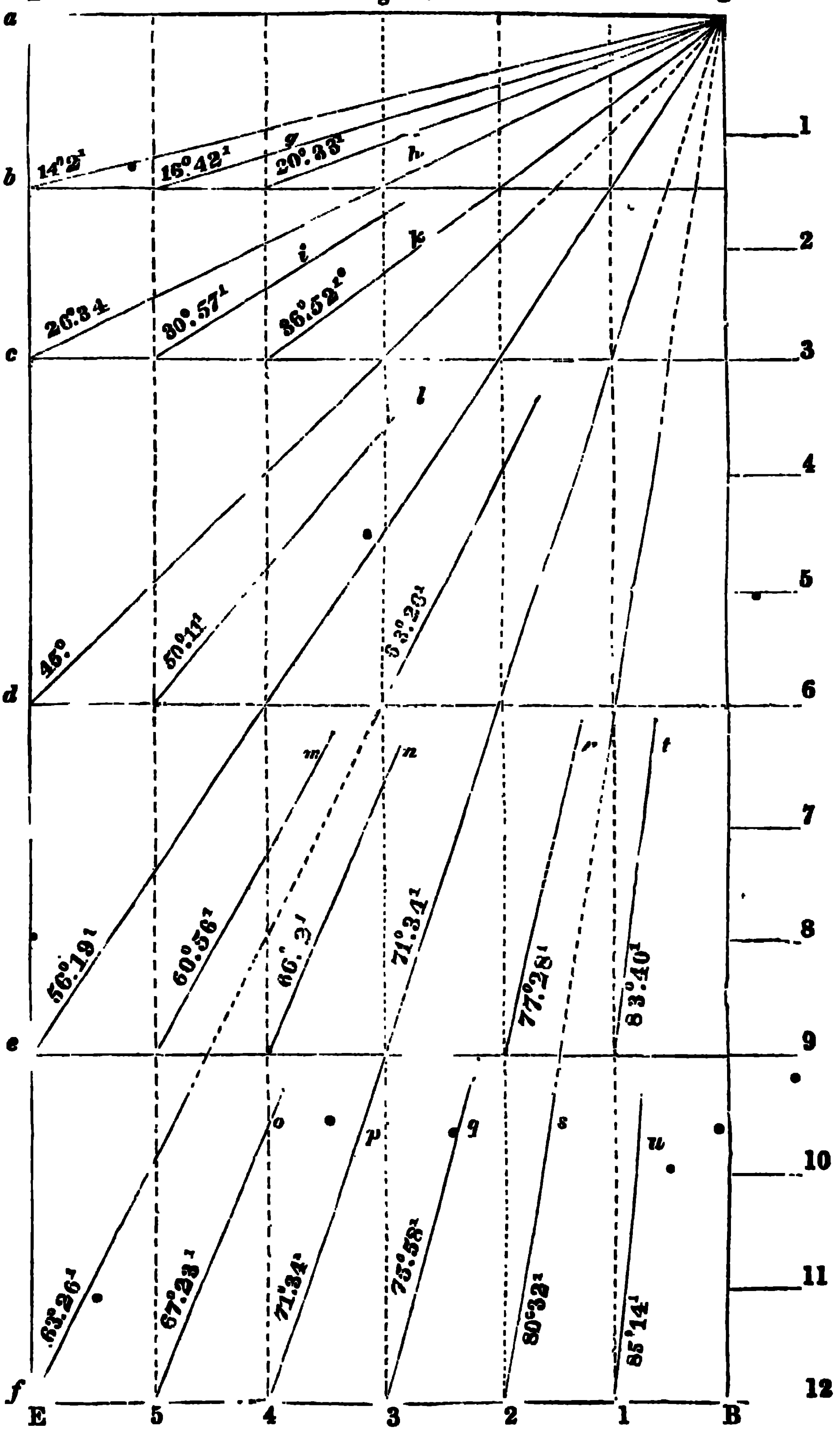
And that these angles are in reality those which will produce the best practical effect may be thus demonstrated: by reference to the figure, it will be seen that the oblique line C *d*, which represents the angle of 45°, intersects the two radius lines above it, *c* and *b*, representing the base lines of angles of 26° 34′ and 14° 2′, respectively, the one at the middle of its length, and the other at one-fourth of its length, from the centre. Hence it follows, that a vane or float, having an angular extremity of 45°, if it present one-half of the diameter of one of 26° 34′, or one-fourth of the diameter of one of 14° 2′, will traverse the same distance in one revolution as either of the others. And what is true of any one angle will be equally true of all others; so that the following rule may be laid down, as of universal application.

"Rule.—To find the angle of a float or vane at any required distance on the radius, the angle at some other distance being given.

"From the point C, on the radius line C *a*, set off the angle of the given distance, and draw a line parallel to C B, from the given distance on the radius line C *a*; then draw through the angle of the given distance another oblique line, until it intersects the parallel line to C B, and from the point of intersection draw a perpendicular to the line C B, on which set off the required distance; the distance C to B intersected by the last-found line, divided by the length of the required distance, will give the tangent of the angle required, and from that tangent the angle required may be found by reference to any table of natural sines. For example: take the intersection of the horizontal line 9 and the vertical line 3; then, 9 + 3 = 3, which is (nearly) the tangent of the angle 71° 34′."

Mr. Biram mentions a very simple and interesting experiment, by which it may be made palpable to ocular observation, " that vanes or floats having such curvilinear surfaces, or presenting such angles as before specified, are calculated to act with much superior efficiency to all others."

Fig. 8.




" Let a vessel of water, of any sufficient capacity, be sprinkled over with small bits of paper, or any other light body of about the same specific gravity, that will float in it; and let a model of a wheel, constructed according to my said improvements, be just

submerged in it, and moved forward in the direction of its axis; the wheel will then revolve freely, but without causing any material agitation either in the water or among the particles floating in it, both of which will remain stationary, those particles of floating matter only being acted upon which come in contact with the edges of the floats during rotation; showing clearly, that the water produces the rotating action with the least possible disturbance to itself. But let the same experiment be made with a model wheel constructed according to any of the common plans, with floats having plain surfaces, and set in any other position to the line of motion than I have prescribed, there will then be more or less a surging of the water in front of the wheel, and the floating particles will be more or less agitated and tossed about, showing no less clearly, that the different form and position of the floats has caused an unnecessary obstruction to the passage of the water."

Wheels with vanes or floats set at angles found or determined by the preceding rules may be also applied to registering the velocity of bodies propelled through water, or of the wind. The manner of such application Mr. Biram illustrates by a description of the means to be adopted in the case of registering the velocity of a vessel at sea; but the details of this we shall for the present pass over.

In machines which act upon water or air, instead of the water or air acting upon them, and which derive their motion from some other source, as steam or animal power, a different principle from that which has been previously explained prevails. Mr. Biram examines, first, the case of propellers of vessels applied at the stern, and rotating in a plane perpendicular to the vessel's path.

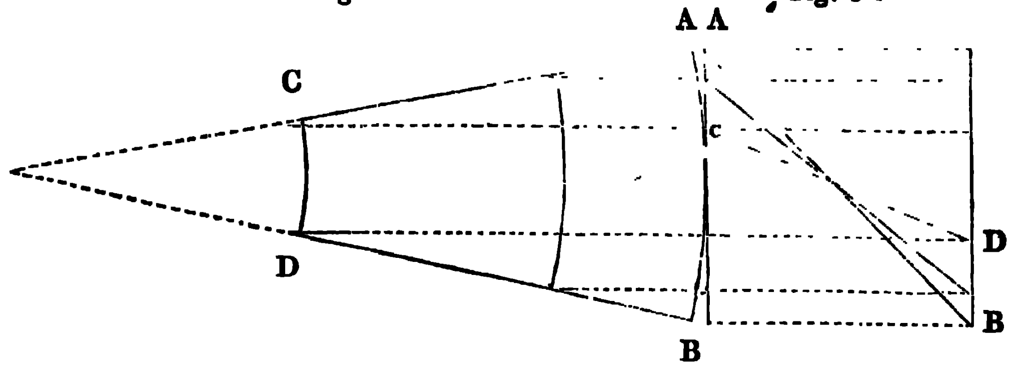
"Here the useful effect produced by one revolution of the wheel may be said to be increased, the more the angles of the vanes or floats with the plane of motion is increased, within certain limits, which may also be illustrated by reference to figs. 6 and 7, before described; for if the vanes of the wheel, W, are at an angle of 56½°, a cylinder of air or water will pass through it in one revolution, equal to the depth of the column H D; whereas, at 45° only, the depth of the said column would be only equal to G D, or the height of the wheel's circumference."

Mr. Biram gives a representation of a pair of stern propellers constructed according to these conditions, and intended to be worked entirely under water. The floats present at their extremities an angle of about 56°, (those of the two wheels being inclined reverse-wise to each other,) and are confined to their position by two rings upon their peripheries. Each propeller or wheel is one-fourth less in diameter than the ordinary paddle-wheel, and only of one-fourth the width. "The result of several experiments made with these stern propellers," says Mr. Biram, "shows that they are, as nearly as may be, of equal power with the common paddle-wheel of larger dimensions, besides possessing the advantage of being worked under water, and at a part of the vessel where they do not interfere, as at the sides, with her sailing capabilities." The tremulous motion so often complained of in steam-vessels is also altogether obviated, or nearly so, in consequence of the oblique manner at which the paddles enter the water, and their reduced number.

In figs. 1 and 2, (see front page,) are given side and end views of a paddle-wheel to be applied to the *sides* of vessels, constructed according to the conditions before explained.

"A A are two metal frames, having six arms and two concentric rings, which are fastened upon the axles on each side. The arms are fixed in an oblique position with regard to each other, those on the reverse side of the wheel being represented by *a a*. B B are six side-plates, which inclose the wheel on each side between the concentric rings of the frame, to the extent shown by the shaded parts, and are screwed or riveted to the frames A A. The shaded parts representing the said plates, together with the projecting ends of the paddles marked C, also show the outline of the paddles when viewed sideways, as in fig. 1. The paddles or floats, C C, which are also screwed or riveted to the frames A A, are placed diagonally across the shaded part of the wheel, and their extremities present an angle of 45° with the side of the wheel, and each point of the extremity radiating to the centre of the wheel, in lines parallel with the side, so that the angle which the paddle makes with the side of the wheel is constantly increasing from the extremity inwards, and would be at the inner ring about 68°. The better to illustrate the form of the wheels, I have given in figs. 3 and 3ª diagrams of the side and end views of one of these paddles. In fig. 3ª, (in which the obliquity of the paddle is shown the reverse way to that intended to be represented by figs. 1 and 2,) A B represents the angle at the inner ring, corresponding with C D, fig. 3."

Fig. 3. Fig. 3a.




The form which Mr. Biram recommends for the ventilation of mines is the same as that before described as suitable for stern propellers. The sort of power best adapted to give them the required velocity will, of course, depend on local circumstances; but the following suggestions are thrown out, as generally worth attending to.

"When applied at the bottom of a shaft, down which there may happen to be a considerable fall of water, I would recommend that the water should be collected in a pipe, and made to impinge on inclined vanes at the extremity of the wheel, (which will give it a great velocity,) but the water vanes must be curved in the opposite direction to the vanes of the ventilator, and at the top side they should be so inclosed as to prevent the air being forced through them, which would have a counteracting effect. When the ventilator is to be fixed at the top of a shaft, it will be found of advantage to have a revolving cap with sails over the pit mouth, on the same principle, exactly, as the self-regulating revolving caps of windmills, and on the sides of this cap, opposite to the wind, to have a circular opening, in which the ventilator may be placed. Such an apparatus would always act well when there was wind; and when the weather was calm, the ventilator might be set in motion by connecting it with a heavy weight, allowed to descend the shaft, and raised from the bottom of it, from time to time, by means of horse, or some other power."

## THE BOCCIUS LIGHT.

Sir,—With all your professions of impartiality respecting the merits of this new light, it is rather surprising that you should pass over, wholly unnoticed, one of its principal recommendations, namely, the absence of all flickering, and the unrivalled steadiness and uniformity of the light. Can as much be said of any other?

I am, Sir, yours,

AN OBSERVER.

Charing-cross, September 26, 1842.

[We did not notice this alleged "absence of all flickering," for the best of all possible reasons, namely, that the flickering is but concealed from view, and *not* really absent. Neither did Messrs. Brande and Parkes notice it in their Report, even though *done to order*—we presume, for the same reason. If our correspondent will take a metal cylinder, of a line or two less than the exact diameter of the flame of a tallow candle, and pass it down just over the top of the flame, he will find that there is quite as little flickering *visible* as in the case of the Charing-cross phenomenon. Now, this is literally all that Mr. Boccius has done—all, indeed, that there is new in his most ridiculously-extolled invention.—ED. *M. M.*]

## DESCRIPTIVE NOTICE OF THE "GREAT NORTHERN" STEAMER (WITH SCREW PROPELLER)—AND REPORT OF EXPERIMENTS MADE TO TEST THE DIAGONAL SYSTEM OF PLANKING ON WHICH SHE IS CONSTRUCTED. BY GEORGE BAYLEY, ESQ., MARINE SURVEYOR, LLOYD'S.

Sir,—The steam ship, the *Great Northern*, was launched at Londonderry, Saturday the 30th July last, from the ship-yard of Messrs. W. Coppin and Co. She is intended to be propelled by Smith's screw propeller, which is fitted in a space

left for the purpose in the dead-wood abaft. The screw is 11 feet long and 14 feet pitch, and is intended to make 88 revolutions per minute. The screw is to be driven by a pair of engines of the estimated collective power of 360 horses, working at a pressure of 3 lbs. to the inch.

These engines, with their boilers, will occupy a comparatively small space in the after part of the hold abaft the main mast, leaving a much larger portion of the ship than usual for the purpose of carrying cargo and passengers.

The *Great Northern* will present the external appearance of a large full rigged frigate with a flush deck.

Her form is calculated for great velocity under canvass, and does great credit to the skill of the constructor.

Without entering into a detailed description of her construction, it may suffice to say, that the frame and outside planking are arranged in the usual manner; and that the ceiling, or internal planking, is arranged diagonally in two thicknesses from the gunwale to the bilge, where it is connected in a peculiar manner with the thick planks at the bilge. This arrangement is expected to prevent any alteration of form from the necessarily unequal distribution of the weights on board with reference to the volume of water displaced at particular parts of the ship.

This point has not been generally attended to in the construction of steam-ships, and the consequence is, that there is scarcely any steamer to be found that does not very soon after being afloat, undergo a considerable, and often a very perceptible alteration in her sheer.

After the *Great Northern* was launched, it was ascertained that she had broken her sheer only $\frac{5}{8}$ths of an inch, instead of several inches, as is frequently the case in vessels built in the usual manner.

In order to show the comparative stiffness and rigidity of his method of building, Mr. Coppin furnished the writer with three models, of the same length, breadth, and depth, and containing precisely the same quantity of materials in each, made from the same plank.

Number 1—A model 6 feet long, $9\frac{5}{8}$ inches wide, and $9\frac{1}{4}$ deep, planked in the usual mode.

Number 2—A model of the same dimensions as Number 1, planked outside in the usual manner. The inside planking in two thicknesses, was arranged so as to form an internal truss, abutting upon shelf or string pieces, and acting by *compression*.

Number 3—A model of the same dimensions as the two preceding, and planked outside in the usual manner. The inside planking in two thicknesses, was arranged so as to act by *tension* only, being without any abutments.

The three models were then loaded carefully as follows:—

*First Experiment.*

Number 1—280 lbs., deflected $\frac{1}{2}$ inch,
Number 2—1120 lbs., deflected $\frac{1}{8}$ inch,
Number 3—2100 lbs., deflected $\frac{3}{16}$ in.

*Second Experiment.*

Number 1—490 lbs., deflected $1\frac{1}{4}$ inch, and appeared to be near the breaking point: on removing the weights, it had received a permanent set of $\frac{1}{8}$th inch.

The other models were not tried with any greater weights than in the first experiment; on their removal the models *returned to their original form.*

The models were made of yellow pine; all fastened in the same manner, with the same number of wooden pins driven after an $\frac{1}{8}$th inch belt.

The dimensions of the *Great Northern* are:—

| | ft. | in. |
|---|---|---|
| Length between the perpendiculars | 221 | 9 |
| Extreme breadth ............... | 37 | 0 |
| Depth in hold .................. | 26 | 5 |

Tons 1,430 old register measurement.
—— 1,514 new register measurement.

It is estimated that her velocity will be nine miles an hour, when the screw makes eighty-eight revolutions per minute.

The following vessels have been already built and fitted with the screw propeller.

| | | | Ports belonging to. |
|---|---|---|---|
| Archimedes | 237 tons | 70 horse power. | London. |
| Princess Royal | 101 tons | 45 horse power. | Brighton. |
| Bee | 30 tons | 10 horse power. | Portsmouth. |
| Beddington | 270 tons | 60 horse power. | South Shields. |
| Novelty | 300 tons | 25 horse power. | London. |

The following are building:—

| | | | Ports belonging to. |
|---|---|---|---|
| Great Britain | 3600 tons | 1000 horse power. | Bristol. |
| Rattler | 800 tons | 200 horse power. | |
| Two for the French Government | | 120 horse power. | France. |
| One for ditto | | 350 horse power. | Ditto. |

Propellers on the same principle have been fitted to some other vessels by other parties, with various degrees of success. The old river steamer *Swiftsure*, has been fitted with one, and it is said that a considerable increase of velocity has been obtained. Ericsson's propeller is substantially the same in principle, and is said to answer well. The same remark applies to that patented by Captain Carpenter.

It is not my intention to trespass upon your pages by any further remarks, upon the merits or demerits of the screw propeller, as they have already been brought under the notice of your readers by gentlemen who have devoted much time and attention to the subject.

Mr. Barlow gives six tons per square inch as the ultimate tenacity of yellow pine; whilst a square inch of the same material is crushed by ·86 of a ton, or about one-seventh of the weight.

Mr. Coppin's plan is by no means new in principle. Some years since a patent was taken out for building vessels with several thicknesses of plank arranged diagonally; but either from the want of tact on the part of the patentee, or more probably, because vessels so built, were found deficient in transverse strength, the plan was not acted upon to any extent. This I think must have been 25 years ago.* About twenty two or three years since Messrs. Tindale of Scarborough, applied diagonal suspension plates upon the inside planking of some vessels built by them, and soon afterwards doubled several of their vessels with thin planking outside, arranged diagonally, so as to act by tension only; this doubling was found to add so much to the longitudinal strength, as almost entirely to prevent any alteration of the sheer, and in no instance have I been able to discover any indication of straining at the ends of the planks.

Some years since, about 1816 or 1817, several of the steam vessels built in the Thames had suspension plates introduced upon the timbers under the planking. This plan was adopted by Messrs. John Wood and Co., in the Clyde, about the same time, they having had particular reference to the unequal distribution of the weights in steam vessels, in arranging the plates, and succeeded in preventing that breaking of the sheer which is too often seen in steam boats.

Mr. Oliver Lang, the talented master shipwright at Woolwich Dockyard, was amongst the first to apply the tenacity of iron plates to the strengthening our men-of-war. So nearly contemporaneous was its adoption in this form to the same purpose in naval architecture by different individuals, that it is difficult to say to whom the priority belongs. It is highly probable, that having their attention called to the defective construction of our ships in regard to longitudinal strength, they arrived, as they must of necessity have done, at the same conclusions as to the nature and operation of the causes producing the defect complained of, and applied the tenacity of iron to remedy it.

Sir Robert Seppings and others had attempted to remedy it by applying the power of wood to resist compression, to counteract the tendency to hog, or arch.

General Bentham and Mr. Gabriel Snodgrass, were in a certain sense the predecessors of Sir Robert Seppings in the application of timber and iron for this purpose.

Admiral Chapman, the eminent Swedish naval architect, in 1767, published in his great work a plan in which the same principles of construction are adopted in the internal framing of the ship.

In civil architecture, truss framing has been long used; but the practical difficulties in the way of its successful application to naval architecture, and perhaps the prejudice in favour of accustomed practice, have prevented its general use in that department up to the present time.

I am, Sir, yours respectfully,

GEORGE BAILEY.

London, September 20, 1842.

* There was a plan for the same purpose, of a much older date than that alluded to by our esteemed correspondent, namely, that of Messrs. St. Barbe and Stuard, the patent for which was taken out February 4, 1796.—ED. M. M.

## LIFE ASSURANCE.

Sir,—Iver Mac Iver, in No. 997, page 276, requests the opinion of your correspondents on the compatibility of a table of rates which he gives, with the benefit promised in return. The benefit is an *endowment*, as it is technically called, of 100*l.*, to be received at the age of 21, and the rates are the annual premiums to be paid from the time of effecting the assurance till the benefit become due, the premiums of course to cease, as well as the title to the benefit, in the event of the party dying before the age of 21.

Iver Mac Iver seems to think that the premiums are too high, and I confess that, until I looked into the matter, I was of the same opinion. Whether or not I am so now will appear by-and-by. I have been at the pains to calculate the following table, which will enable your correspondent to judge for himself:—

| Age. | Annual Premiums. | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Iver Mac Iver's Rates. | | | Northampton, 3 per cent. | | | Carlisle, 3 per cent. | | | Government (Males) 3 per cent. | | |
| | £ | s. | d. | £ | s. | d. | £ | s. | d. | £ | s. | d. |
| 1 | 3 | 5 | 6 | 3 | 0 | 5 | 3 | 5 | 0 | 3 | 6 | 1 |
| 2 | 3 | 10 | 6 | 3 | 6 | 8 | 3 | 10 | 10 | 3 | 11 | 1 |
| 3 | 3 | 17 | 6 | 3 | 12 | 10 | 3 | 18 | 9 | 3 | 16 | 8 |
| 4 | 4 | 4 | 0 | 3 | 19 | 5 | 4 | 3 | 6 | 4 | 2 | 10 |
| 5 | 4 | 11 | 3 | 4 | 6 | 7 | 4 | 10 | 9 | 4 | 9 | 10 |
| 6 | 4 | 19 | 9 | 4 | 14 | 9 | 4 | 18 | 10 | 4 | 17 | 9 |
| 7 | 5 | 9 | 10 | 5 | 4 | 0 | 5 | 8 | 0 | 5 | 6 | 10 |
| 8 | 6 | 1 | 2 | 5 | 14 | 6 | 5 | 18 | 8 | 5 | 17 | 3 |
| 9 | 6 | 14 | 8 | 6 | 6 | 9 | 6 | 10 | 11 | 6 | 9 | 5 |
| 10 | 7 | 10 | 6 | 7 | 1 | 3 | 7 | 5 | 6 | 7 | 3 | 11 |

The first column contains the age at which the assurance is effected; the second the annual premiums given by I. M., and the other three the premiums according to the mortality tables and rate of interest indicated, without any addition in the shape of commission.

On comparing I. M.'s premiums with those in the other columns, it will be seen that they correspond most nearly with those calculated by the Northampton Table; that is, the differences between the corresponding premiums are in that case the most regular, although there are, even here, discrepancies enough to show, either that the Northampton Table cannot have formed the basis of the calculation, or that a different rate of commission has been added to the premiums at different ages. However, the correspondence is near enough to enable us to form a judgment as to the sufficiency of the rates.

I. M.'s premiums (I call them so for brevity) then, it will be seen, with an average addition of about 6 per cent., correspond pretty nearly with those deduced from the Northampton Table. Now, supposing the Northampton Table to give a tolerably correct approximation to the mortality which will be experienced amongst the assured at the ages under

consideration, and that 3 per cent. is the highest rate that can be calculated upon for the safe investment of money (which in the present state of the market is the fact)—I say, making these suppositions, it will be allowed by all who have paid any attention to the subject, that an addition of 6 per cent to premiums calculated on these data is wholly inadequate to provide for expenses of management and risk of fluctuation in the rates of both mortality and interest, to say nothing of profits to members or share-holders. On these grounds, therefore, I think we are warranted in saying that the premiums are inadequate.

But it is well known that the Northampton Table indicates a rate of mortality, especially at the younger ages, (which are just those with which we have at present to do,) far greater than has ever been experienced in any assurance society. By the showing of Mr. Morgan himself, who was the great patron of this table, the number of deaths between the ages of 10 and 20, in the Equitable Society, during an experience of fifty years, were only half those predicted by the Table referred to. And certainly when, as in the case before us, it is the interest of the parties effecting the assurances that the lives put in shall be as good as possible, it were folly to calculate on a greater rate of mortality than other offices have experienced in less favourable circumstances. But the effect of calculating in assurances of the kind under consideration, according to a higher rate of mortality than will actually be experienced, is, to give the annual premiums under their true value, since more will be alive to claim their endowments than the table predicted, and consequently, than the premiums were intended to provide for. It is true that, when the benefit is to be paid for by *annual* premiums, a compensation to some extent will take place; since, if the assured die off more slowly than was anticipated, more premiums will be received; and it is even possible that in particular instances the compensation will be exact. But an exact compensation *at all ages* can never possibly take place: since, leaving the rate of interest out of view, the amount of the benefit depends solely on the *aggregate* mortality between the age at which the assurance is effected, and that at which the benefit becomes due, while the amount of the premium depends as well on the *progressive rate* of mortality between the same ages. It will be safer, therefore, to calculate the premiums for such assurances by tables which indicate a lower rate of mortality than the Northampton Table.

Such are the Carlisle and the Government Tables, the premiums derived from which I have given above. It will be seen that these premiums differ but little from each other; while they are, in every case, higher than the Northampton premiums, and generally a mere fraction under those given by Iver M'Iver. Hence, the conclusion becomes still more unavoidable, that the last-named are inadequate. But are the tables from which these higher premiums have been deduced to be depended on, as giving a correct representation of the mortality which will be experienced at the ages under consideration? As regards the Carlisle Table, Mr. Milne, by whom it was compiled, states that, in consequence of the introduction of vaccination, since the observations on which the table is founded were made, the mortality indicated in the table at the early ages is greater than may generally be expected. And the Government Table we may presume to be in a similar predicament. Hence, it will be unsafe to make use of the premiums derived from these tables, without a considerable augmentation; and hence, also, an office which should confine its business to assurances of the kind under consideration, at the rates given by I. M., could hardly fail to be ruined.

It may be satisfactory to some of your readers that I should explain the method by which the foregoing table has been calculated. The calculation was made by means of the formula which I gave in a previous communication, at page 117 of your present volume; and the elements, in the cases of the Carlisle and Northampton Tables, were taken from Mr. Jones's work on Annuities; and in the case of the Government Table, from a table constructed from the data contained in Mr. Finlaison's Report on the Mortality of the Government Annuitants. (Parliamentary Paper, No. 122, 1829.) The formula referred to is,

$$p\ (x) = \frac{s\ \mathrm{D}\ (x+n)}{\mathrm{N}\ (x-1) - \mathrm{N}\ (x+n-1)}$$

which in this case becomes, $s$ being equal to 100, and $x + n = 21$,

$$p(x) = \frac{100\ D\ (21)}{N\ (x-1) - N\ (20)}$$

The values of this expression for each value of $x$, from $x = 1$ to $x = 10$, are the premiums required.

In using the Commutation Tables, not only is the mode of operation more simple, generally, than by any other method; but, when we have a series of values of any given benefit to calculate, we almost always meet with facilities, which, besides materially abbreviating our labour, also afford the means of proving the accuracy of part, at least, of our work. Thus, in the case before us, the numerator of the foregoing expression is constant for all the values of $x$, and the denominator alone varies. And we observe that the difference between any two successive values of the denominator, (those corresponding to $x = 1$ and $x = 2$, for instance,) is N (0) – N (1.) Now, by the construction of the Commutation Tables, N (0) – N (1) = D (1.) Consequently, if the value of the denominator corresponding to $x = 1$ be found, that corresponding to $x = 2$ will be found by subtracting D (1) from the first value; also that corresponding to $x = 3$, by subtracting D (2) from the second value; and so on for the rest. And the verification is afforded by comparing the value corresponding to $x = 10$, obtained in this manner, with the same value obtained by subtracting N (20) from N (9). Those who are accustomed to calculations of this kind will appreciate the facility afforded by the mode of operation I have described, as well as the advantage of the final verification. When the denominators are thus found, their logarithms, subtracted successively from the logarithm of the numerator, give the logarithms of the required values of $p$.

So obvious are the advantages of the employment of the Commutation Tables, for the calculation of the values of benefits depending on life contingencies, that I believe their being so little known and used for this purpose arises from the want of a systematic treatise upon the subject. To contribute in some degree towards supplying this deficiency, I am tempted to offer you a few short papers in illustration of their construction and applications. In drawing them up, I should be largely indebted to Professor de Morgan's able articles in the "Companion to the Almanack," to which I formerly referred. These articles, however, avowedly contain almost nothing of demonstration; and it is of this deficiency that I chiefly complain, and which I should make it my study to supply.

May I, notwithstanding the length to which the present article has insensibly grown, still beg space for a remark or two on the manner in which Mr. Scott has chosen to solve Iver M'Iver's former problem? Mr. Scott seems to entertain a most magnanimous contempt for the labours of his predecessors in this branch of science. The results of these labours have been published expressly for the purpose of facilitating the enquiries of those who should come after; yet Mr. Scott stubbornly refuses to avail himself of them, and gives clumsy theorems for the solution of particular cases, which may be solved in their utmost generality at one-tenth of the labour, by availing ourselves of the tables which have been published. In finding the value of a temporary annuity for nine years, which was necessary for the solution of the problem referred to, Mr. S. chose to do so (page 114) by a method which involved nine divisions by as many different divisors of seven figures each, and one addition of nine lines; while the value might be found from the published tables, as I showed in my first solution, (page 116,) by two multiplications, one division, and a subtraction. By my second solution, only one subtraction and one division are required for the whole solution. Moreover, had the duration of the annuity been doubled, so also would Mr. Scott's labour, while that by the method I employed would have undergone no increase. If the facilities afforded in calculation by the use of logarithms be not too great to suit Mr. Scott's taste, he will of course, when he has occasion for them, if he act up to his principles, disdain to take them from a published collection, but will insist on calculating them in every case for himself!

Seriously, Mr. Scott ought not to act in this manner. If every one were to do so, and refuse to avail himself of the labours of his predecessors, in matters of mere drudgery, the advances of science would be slow indeed. I trust I have said enough to make this obvious.

I am, Mr. Editor, respectfully yours,

G.

Hermes-street, Pentonville,
September 21, 1842.

### MR. HALL'S COAL-CONSUMING CLAIMS.

Sir,—In forwarding you my first letter in reply to Mr. Samuel Hall's advertisement, as it appeared in the *Mining Journal* of the 10th instant, and which you will be pleased to insert also as an advertisement,* I have to request your readers will suspend their opinions with respect to the several points not yet commented on by me, assuring them that none shall remain unnoticed. They will perceive that the use of coal in locomotive engines, on Mr. Hall's plan, is, in the opinion of almost all, (Mr. Hall himself, of course, excepted,) attended with such uncertainty and expense as to be impracticable. I hope hereafter to give the reason *why*. I may here just observe, that, although on many railroads coal is used with advantage, except as regards the nuisance from smoke, yet, the moment we attempt to burn the 10,000 or 12,000 cubic feet of gas which each ton of coal evolves, the admission of the enormous volume of air which such gas demands, induces so many difficult chemical conditions, and such a complex process, as almost to defy our efforts in effecting complete combustion, and avoiding the nuisance of smoke. The subject is one of great difficulty, in a chemical point of view; and I propose, hereafter, directing attention to its details, as regards locomotive engines. In land boilers, and the greater number of marine boilers, the difficulty has already been surmounted.

I am, Sir, yours, &c.,

C. W. WILLIAMS.

Liverpool, September 21, 1842.

### THE SUBSTITUTE FOR A FLY-WHEEL, AT MR. LUCY'S, BIRMINGHAM.

Sir,—Would any of your readers be so kind as to describe the substitute for a fly-wheel, weighing 24 tons, removed from Mr. Lucy's steam-engine, of Birmingham, and by which the performance was increased 10 per cent., as stated by Mr. Parkes in the course of the discussion on Mr. Mosley's Indicator, at the Institution of Civil Engineers, as reported in your Magazine, at page 139 of the present volume. The discussion in your papers relative to the loss of power in the crank might be benefited by the information.

Yours, &c.,

A LOOKER-ON.

* See Cover of this Number; also, Cover of the Monthly Part for September.—Ed. M. M.

### IMPURE WATER THE CAUSE OF FOUL CISTERNS — IMPROVEMENT IN CONSTRUCTION OF CISTERNS SUGGESTED.

Sir,—Controversy on practical subjects generally evolves something of public utility. One thought suggests another; and your Periodical, by giving expression to diversities of opinions, leads on discussion, until the public obtain some beneficial result.

Your correspondents, B. and Mr. Baddeley, seem to think differently about the chief sources of the impurities of the water in our cisterns, and, consequently, about the remedy to be applied. It is an occurrence so frequent as to have become an axiom, that when a man finds he has the worst of an argument, his sensitiveness is more remarkable than his sense; and the last communication of Mr. Baddeley is, I think, an instance of this kind.

Mr. Baddeley would have us believe, 1. That the water comes into our cisterns comparatively pure; 2. That it gains its chief impurities from the deposits retained in the cisterns; 3. That these deposits are not from the water supplied, but from the spiders, moths, flies, blacks, and such-like nuisances as abound in the places where cisterns are generally fixed; 4. That if we were careful to keep our cisterns clean, we should have *pure* water.

In answer to the first of these propositions:—There is the fact, that the water as it comes, not from the cistern, but from the main, is so thick as to be unfit to drink, or to use in the preparation of food; and that this water, by being undisturbed for some time, becomes clear—that is, through the impurities, which occasioned its muddiness, settling down to the bottom of the vessel.

This fact militates as much against the remaining three propositions as it does against the first. If we get a pail of water from the main, and let it settle, the bottom of the pail receives the deposits; if the same water comes into our cisterns, they receive the deposits. These deposits are increased by every supply of water. Most people would reckon that three days of such deposits as these would be equal to a hundred days of such accidental deposits as Mr. Baddeley speaks of; and it is because they do reckon in this way, that they deem it labour in vain to clean their cisterns out, in expectation of getting clear water. Give them clear water into their cisterns, and nine in ten would take pains to keep them clean. But now, if they were to clean out their cisterns every day, they would be still as far as ever from obtaining pure water.

These reflections on the deposits in our water cisterns have suggested to my mind the possibility of devising another remedy

besides that of Mr. Stuckey. Under the best system of filtration, deposits will take place; and it would be a great improvement if, by some change in the shape of the bottom of the cistern, or in the shape and position of the cock, these deposits could be prevented from accumulating. At present, there is between the cock and the bottom of the cistern a perpetual substratum of stagnant water, which forms a breeding-ground for worms and other animalculæ.

All your readers know that Mr. Baddeley possesses much ingenuity, and perhaps, in his zeal for the public good, he may supply some remedy for this evil; so that, by the time the public obtained *Stuckeyfied* water, they might also have butts which would not retain deposits so *badly*.

I am, Sir, yours respectfully,

J. Cole.

Old Kent-road, September 27, 1842.

THE WATER QUESTION—STUCKEY'S FILTRATION *v.* BADDELEY'S CISTERNAGE.

Sir,—I am glad to perceive my "veteran" opponent, (Mr. Baddeley,) is anxious to have it believed that he is neither influenced by a desire to serve the Water Companies, nor to deprecate the forthcoming Parliamentary Inquiry into their "sins of omission." I at once apologize for having so far libelled him as to imagine that he had such objects in view; but perhaps he will pardon me while reflecting that he himself acknowledges that he has been "driven into the position of an apologist for the Water Companies," however "uncongenial" such a task may be to his feelings, and the more especially, if I happen to demonstrate that the case he attempts to make out, of the comparative innocence of those Water Companies in producing the filthy and foul beverage their customers swallow, is so utterly against both science and evidence, that no man who knows any thing of Mr. Baddeley's talent and information would for a moment believe that he could honestly hazard such assertions, or profess such opinions. Nevertheless, I was wrong—I confess it. Mr. Baddeley, in making the statements he has done, that "nine-tenths" of the bad water arise from the *laches* or neglect of the customers, and not "one-tenth" from any fault of the Companies—that, in truth, in defying me "to produce a single case of the slightest indisposition produced by water as supplied by any of the public Companies," he was really, all the time, a decided water reformer—a "veteran" associate—one who wished to induce or compel the Water Companies to adopt Mr. Stuckey's plan of filtration; nay, to give him "a push behind on any stop-short movement." It *may* be so—it *must* be so—and the only way to account for it is, on the hypothesis of Butler, that Mr. Baddeley belongs to that species of character described as men

"——— who may have wit,
But who are *shy of showing it!*"

Like the prophet of the heathen king, he blesses those whom he intended to curse: meaning to fight on any side, he commences operations by giving up the citadel. He thinks the Water Companies "ought to amend their water;" but then, "there is not a single case of the slightest indisposition produced by it!"

Call you this a "backing of your friends," Mr. Baddeley? Truly, they are very *badly* backed!

Why should the Water Companies amend their water, if no indisposition be produced by it?

Well, however, friend or foe, Mr. Baddeley's defence is a bold one, and it shall be boldly met. He shall have evidence so strong, so full and so complete of the fact that he defies me to prove, that, if he be not convinced, "the eye of his faith" must be "dim" indeed; so much so as to make an unkind public suspect that he has shut it, on purpose not to see.

A noble lord who has gained some laurels in America just now, before he went to smoke a pipe with brother Jonathan, said some 18 months ago that the water supplied to him was so bad and filthy that saying nothing about drinking it, he positively *would not take a bath in it*, no matter which of the Companies supplied him. I make no war on individual Companies—such, however, was the fact. The head of the great house of Baring thought differently on this subject from the head of the great house of Baddeley.

But now for proofs, as to the two points of Mr. Baddeley's letter,—1st, that the water supplied by the Water Companies is deleterious and destructive to health, and 2nd, that when water is delivered pure into cisterns it remains so for a great length of time. I propose to adduce extracts from the evidence as given before Committees of both Houses of Parliament, and before the Royal Commissioners of the following among other individuals, Dr. James Johnson, Dr. Kerrison, Dr. Bostock, Dr. Paris, Dr. Yeates, Dr. Wm. Somerville, Dr. Hoffman, Dr. Lind, Dr. Mead, Dr. Wm. Lambe, Abernethy, and a host of non-medical men to prove the deleterious, dangerous, and fatal effects of that very water which Mr. Baddeley, in his innocence, declares never to have produced "the slightest indisposition;" and in the second place to establish my position,

that if pure water be delivered into cisterns, it will be a long time before all the "flies" and other friends of Mr. Baddeley, will make it unfit for the "swine" who have to drink it. * * * * *

I have the honour to be, &c.

B.

Grafton-street, Sept. 26, 1842.

(We have not space in our present number for the extracts furnished by our correspondent, the more especially as we have inserted another letter upon the same subject from Mr. Cole. We will try, however, what we can do in our next.—Ed. M. M.)

## THE ROYAL STEAM NAVY.

We extract from the *Times*, the following description of the honorary medal which we were the first to mention in our journal of the 27th August last, had been awarded by the Lords of the Admiralty to the engineer of the *Tartarus*, for his ability and good conduct in the management of the steam machinery of that vessel during her more than four years' service in the West Indies.

"Woolwich, Sept. 22.—The Lords Commissioners of the Admiralty have caused a very handsome silver medal to be struck, to be presented as rewards to engineers of the first class serving in Her Majesty's navy, who by their good conduct and ability deserve some especial mark of notice, and as an inducement to all the members of that rank to strive to obtain this highly creditable token of their Lordships' approbation. The medal, as a work of art, is of a superior description, and the emblematical devices of an elegant yet chaste description. The intrinsic value of the silver must be fully 5s., as, although a small degree less in size than a five-shilling piece, the medal appears thicker, and contrasts strangely with the appearance of the Sultan's medals issued to the officers and men of the Royal Navy and Royal Marines, being equal in quantity of metal to about three of the Sultan's issued to the officers, and of the value of 120 of those issued to the men of the various corps which served in Syria. This medal for first-class engineers is the first of a series about to be issued to the most deserving of that important class of men, on whose ability, exertion, and careful service so much of the efficiency of the steam navy of Great Britain in a great measure depends. On one side of the medal is engraved, on the outer circle, on a frosted ground, 'Mr. William Shaw, first-class engineer, 1842,' and on an inner circle the following letters have been cut in the die, 'For ability and good conduct,' surrounding a neatly-embossed figure of an anchor on a polished surface. On the reverse is a beautiful figure of a steam-vessel with the steam up, richly and tastefully embossed on a polished ground, with a representation of the water, on which she appears to be sailing, formed of frosted silver, having an excellent contrast and very pleasing effect. Underneath is a figure representing the head of Neptune's trident, surrounded by a wreath of oak leaves with acorns. Mr. William Shaw, who has so distinguished himself as to be the first to obtain this testimony of their Lordships' approbation, earned the envious distinction when serving under Commander George W. Smith, then Lieutenant of the *Tartarus* steam-vessel, on the West Indian and North American station."

Without desiring to disparage the moral influence of such testimonials (to say nothing of "the intrinsic value of the silver," being fully 5*s*.!!!) we must still adhere to the strong opinion we expressed some weeks ago, and which we are glad to find has met with the cordial approval of some of the best informed officers of Her Majesty's Navy, that it is *not* by such means that this important arm of the public service is ever likely to attain that high degree of efficiency of which it is susceptible; but by giving the same rank to those who have charge of the *steaming*, as is possessed by those who are intrusted with the *sailing* of Her Majesty's ships. It has been objected to our plan by "A Ward-room Officer," who has sent us a more saucy than sensible letter on the subject, that "no *gentleman* would be found who would subject himself to the fatigue and filthiness of the engine-room." We beg, by way of answer to this, to state a case which has come to our knowledge within these few days—first premising that we are not aware of there being any thing in the superintendence, or even working of steam-engines, which should render it more unsuitable to the habits of gentlemen, than the handling of tarry ropes or rusty shot, with which every ward-room officer is or ought to be familiar. The case is this. When the *Isis*, one of the Royal Mail West India steamers, left England on her last outward voyage, she took out as a passenger Mr. Samuel Clegg, jun., C.E., of whose productions in engineering literature we have more than once had occasion to make most favourable mention; and who, in point of

education, manners, and conduct, must be allowed by all who have the pleasure of knowing him, to be equal to the best companionship which the naval service has to offer. The first engineer of the vessel having fallen sick very soon after her departure, Mr. Clegg volunteered to perform his duties for him, and actually did so all the way to Madeira, (whence the last accounts were dated.) But this is not all; for, availing himself of the opportunity thus afforded him of obtaining a practical insight into the daily working of marine steam-engines, Mr. Clegg has kept what may be called a steam log of the vessel, during the period of his superintendence, which, judging of it from some specimens sent home, is far superior to any thing of the sort ever before furnished, and such as all the honorary medals in the world would never elicit at the hands of men of that "next to caulker" class, to whom Her Majesty's Commissioners of the Admiralty seem at present intent on confiding the exclusive charge of the engine rooms of the Royal Steam Navy. We see in Mr. Clegg exactly the sort of "gentleman" whom we have figured to ourselves a first engineer of one of Her Majesty's steamers should be, and we refer to what he has done on the present occasion, for convincing proofs of the advantage which the Steam Naval Service would derive from the introduction into it, of a class of men of the same grade in respect of education, acquirements, and general intelligence.

## LISTS OF PATENTS GRANTED FOR SCOTLAND FROM 22ND OF AUGUST TO THE 22ND OF SEPTEMBER, 1842.

Job Cutler, of Lady-pool-lane, Birmingham, gentleman, for improvements in the construction of tubular flues for steam boilers, and in the manufacture of tubes for such and other purposes. Sealed August 23.

Henry Barclay, of Bedford-row, Middlesex, dentist, for a composition or compositions applicable as tools or instruments for cutting, grinding, or polishing glass, porcelain, stones, metals, and other hard substances. August 25.

William Edward Newton, of 66, Chancery-lane, Middlesex, civil engineer, for improvements in machinery, or apparatus for making or manufacturing screws, screw blanks and rivets. (Being a communication from abroad.) August 31.

Eugene Varroe, of Bryanstone-street, Portman-square, Middlesex, gentleman, for apparatus to be applied to chimneys, to prevent their taking fire, and for rendering sweeping of chimneys unnecessary. September 1.

Thomas Marsden, of Salford, Lancaster, machine-maker, and Solomon Robinson of the same place, flax-dresser, for improvements in machinery, for dressing or hackling flax and hemp. September 1.

Samuel Morand, of Manchester, merchant, for improvements in machinery or apparatus for stretching fabrics. September 1.

Henry William Kempton, of South-street, Pentonville, Middlesex, gentleman, for improvements in the manufacture of candles. September 2.

John George Hughes, of No. 158, Strand, Middlesex, general agent, for a new application of Telegraphic signals, and the mode of applying the same. September 2.

Joseph Whitworth, of Manchester, Lancaster, engineer, for certain improvements in machinery or apparatus for cleaning roads, and which machinery is also applicable to other similar purposes. September 2.

John Thomas Betts, of Smithfield-bars, London, gentleman, for improvements in covering and stopping the necks of bottles and other vessels. (Being a communication from abroad.) September 8.

Isham Baggs, of Wharton-street, Middlesex, chemist, for improvements in obtaining motive power by means of carbonic acid. September 8.

## NOTES AND NOTICES.

*Figure weaving.*—On Thursday, September 22, a deputation from the committee of figured silk-weavers of Spitalfields proceeded to Frogmore-lodge, for the purpose of presenting to her Royal Highness the Duchess of Kent a specimen of silk-weaving, new, we believe, to the manufactories of this country, but on a principle which has some time been worked by the manufacturers of France. The specimen was a portrait of the illustrious lady to whom it was presented, entirely woven in silk, in a loom and machine of the Jacquard principle. Its dimensions are 14 inches by 10, and the portrait is an exact copy from the engraving published some time since by Mr. Cochran. It is elegantly mounted in a rich gilt frame, and is at once creditable in the highest degree to the skill and industry of the designer and the operative, and well worthy the gracious acceptance of the Duchess of Kent. It has cost in materials, pattern, drawing, &c., upwards of 160*l.*—*Times.* [What is said about this specimen of silk-weaving being "new to the manufactories of this country, but on a principle which has been some time worked by the manufactories of France," is in conformity with the fashionable cant of the day respecting foreign superiority, but is all nonsense. There is but one principle on which figure weaving of every sort is performed, whether in a Jacquard loom or any other,—namely, the principle of squares; and the same machinery which is used to depict imperial tulips and royal dahlias, will produce (with a little more labour only) good likenesses of living duchesses.—ED. M. M.]

*Captain Norton's Concussion Shells, and Mr. Jeffrey's Cement.*—Some further experiments were made on Friday, the 16th instant, in the marshes at Woolwich, with concussion shells invented by Captain Norton, and a massive block of wood, about 5 feet long, and 2 feet 6 inches broad, formed of two pieces about 15 inches square, joined together by the cement noticed on a former occasion, and the invention of Mr. Jeffrey. There were 19 shells fired on Captain Norton's principle; nine of them, being of 8 inches in diameter, were fired from a 68-pounder gun at 400 yards' range, and were constructed with leaden fuzes. Five of these shells answered remarkably well, but four did not burst. The other ten shells (32-pounders) were constructed with wooden fuzes, and nine out of that number burst on striking the bulkhead; the other did not burst. The block of wood submitted by Mr. Jeffrey was bored to the centre, exactly in the middle of the joining, and a 5½-inch shell inserted, for the purpose of tearing it to pieces. On a port-fire being ignited, the shell soon exploded, tearing the solid wood in all directions, and into numerous fragments, but in no part separating the pieces where the joining with the cement was made.

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# Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1000.] SATURDAY, OCTOBER 8, 1842. [Price 3d.

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## GRYLL'S IMPROVEMENTS IN WINDLASSES, CAPSTANS, AND CABLE STOPPERS.

Fig. 1.

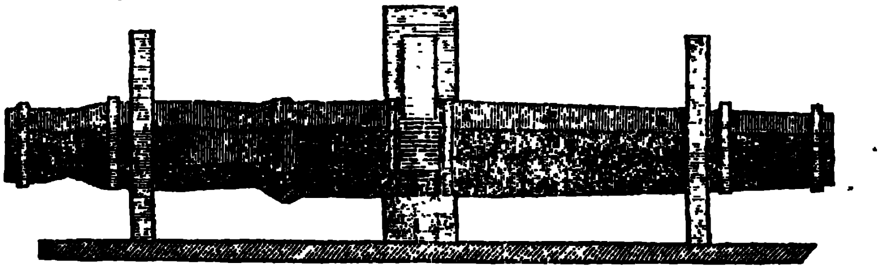


Fig. 2.

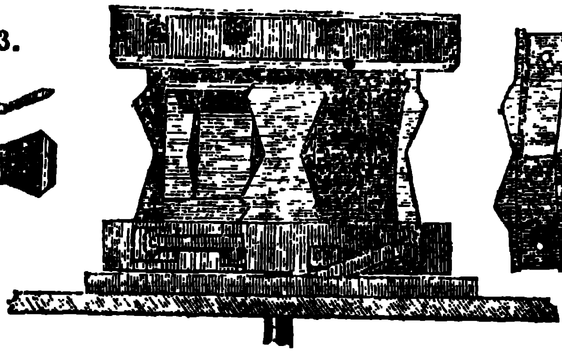


Fig. 3.

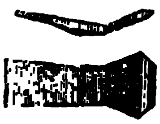


Fig. 4.

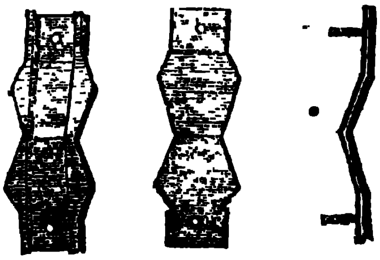
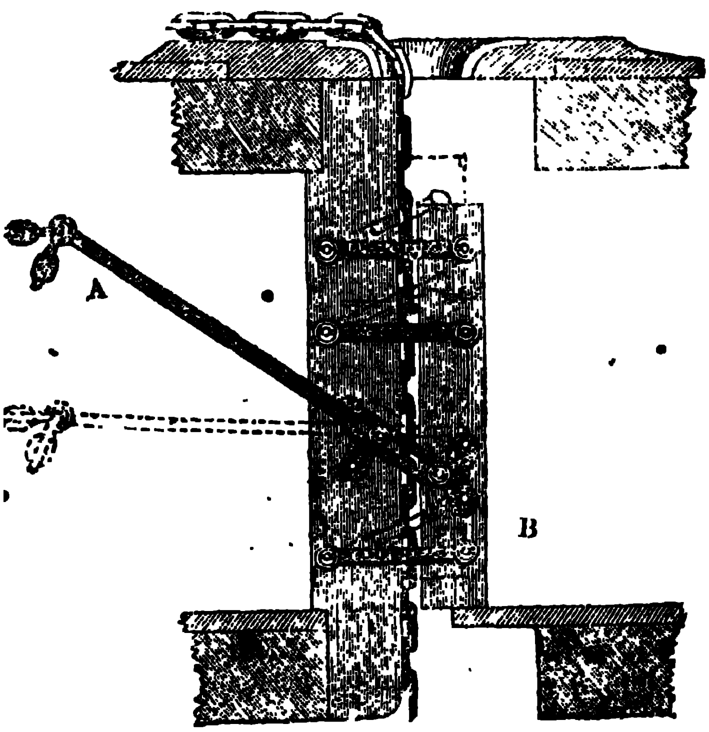


Fig. 5.



## GRYLL'S IMPROVEMENTS IN WINDLASSES, CAPSTANS, AND CABLE STOPPERS.

Sir,—It has long been a desideratum to find some means of obviating the delay and danger in heaving up ships' anchors and cables, arising, from what in nautical parlance is called "*surging*" or "*fleeting over;*" and although several patents have been taken out for this purpose, and many ingenious designs for improvements in windlasses have been described in the earlier volumes of your Journal, I have not met with one which fulfils all the requisite conditions so well as that which I am now about to describe.

By the old methods, whenever a cable was being "hove in," an operation which often requires to be done with the utmost expedition, when the chain or cable had made three or four turns round the barrel of the windlass, it would work to the higher end, or that of greatest diameter, and then immediately require "fleeting over." To effect this, a strong iron claw usually affixed to the "bitts" was passed over the chain, and the strain being transferred from the barrel of the windlass to the bitts, the chain was slacked and passed over to the lower end, or that of least diameter—both a dangerous and tedious operation, and one which, when riding in deep water, required to be frequently repeated.

In Gryll's Windlass, the "fleeting over" is entirely dispensed with, by a very simple contrivance. On the barrel are firmly bolted, what the inventor calls "Whelps," consisting of strong iron plates, forming a double-inclined plane, at the base of which the chain is found to "bight," or hold on securely, and has at the same time no tendency to work up either of the inclines, but keeps steady while getting the anchor."

One of the most disagreeable duties a sailor has to perform, is thus rendered speedy and safe; to say nothing of the saving which will be effected to the owners of ships by the lessening of the wear and tear of rope under the old system of "jerking" or "swinging." Another thing which will also be greatly reduced, if not entirely done away with, is the strain on the vessel which was caused by transferring the strain from the barrel to the top of the windlass, which rendered the forecastle of many vessels leaky in consequence of the "coming up," as it is called, causing an opening of the seams.

The improvement in the capstan consists in substituting whelps of the same kind as those applied to the windlass, for the ordinary straight barrel.

The plan for stopping the cable appears to me to be a decided improvement. By giving a longer grip-hold on the cable, and allowing the leverage to be increased or diminished as required, it will be perceived, that great advantages are obtained.

The East India Company have adopted the windlass and stopper in all the ships recently fitted out by them.

### *Description of the Engravings.*

Fig. 1 is an elevation of the windlass, in which the old and new plans are contrasted. A A, the patent whelps, bolted to the barrel, over which the chain is passed; B B, barrel of windlass on the old plan.

Fig. 2 is an elevation of a capstan with the whelps applied.

Fig. 3, front and side views of the whelp for windlass.

Fig. 4, front and side views of the whelp for capstan.

Fig. 5 is a view of the improved stopper fitted to a large ship, and placed under the gun deck. By bringing the lever A to a horizontal position, the stopper B, will be made to press upon and jam with great force the cable.

I am, Sir, your constant reader,

E. WHITLEY BAKER.

London, August 22, 1842.

## PROGRESS OF FOREIGN SCIENCE.

*Communications to the Royal Academy of France.*

### *Railway Accidents—Fracture of Axles.*

1. M. Séguier proposes, in a paper communicated to the Academy, to account for the fracture of the fore axle of the first locomotive, which produced the accident on the Versailles Railway, by referring it to the variable and continuous

shocks to which this axle is exposed in all four-wheel engines, by reason of the point of traction and the point of adhesion of the wheels upon the rails not being in the same right line.

From the usual arrangement of four-wheel engines, it is habitual to advance with the loose wheels foremost, *i. e.* the driving-wheels behind; the loose wheels are therefore *pushed on.*

" But the effort of a locomotive is produced by the adhesion of its wheels against the rails, in a plane tangential to the moving wheels. The tractation of the engine is transmitted to the train by the points of attachment of the engine and tender to the train, in *another plane* placed above the former by the whole diameter of the wheels: hence, it inevitably results from this arrangement, that the plane in which the resistance acts tends to approach that in which the traction is exercised, that is to say, that the whole mass of the locomotive has a continual tendency to upset backwards, or to turn over round a point which is the centre of the driving-wheels." By reason of this, it sometimes happens that the fore axle of the engine is discharged of a great part of its load, (which at the greatest, when stationary, is only one-third of the engine;) while at other moments, by the advance of the train, and its pushing the engine from behind, this same axle is exposed to a more than ordinary stress, (by the inversion of the forces before described;) and from inequalities in the road and in the moving force, these alternate pullings and pushings are continually taking place. To this cause the author ascribes the fracture of the axle on the Versailles Railway. He does not enter into the question of the advantage of four or of six wheels; but considers that such arrangements might be made in the four-wheel engine, as would enable the driving-wheels to be in advance, and thus at once get rid of the foregoing cause of unequal strain, but also of the tendency to run off the rails, which the wheels in advance in four-wheel engines, as now made, being pushed in place of pulled, must always subject them to.

M. Séguier concludes by stating, that he will shortly lay before the Commission of the Institute a method by which he considers it possible, by an application of M. Dobo's mode of rectilineal brake, to obtain from the *weight itself* of the masses moved the most effective means of destroying, progressively, their acquired velocity.

2. The next communication we have to notice is one by M. François, Mining Engineer, entitled, " Note on the molecular changes which are produced by use in iron exposed to strains, (*pieces de resistances,*) and especially in axles; on the manufacturing of these; and on the means of preventing these changes." This paper is far from clear in its views or expressions, and it may be doubted how far it is even correct in fact.

The author considers wrought-iron as a mixture of pure metal and certain imperfectly reduced metallic slags, of definite chemical constitution, which he calls the " *silicate multiple neutre.*" He affirms that these crystallize in the substance of the iron, in obedience to certain undefined *thermo-magnetic* forces. When a bar is first rolled, it sustains a powerful magnetic excitement; if it be again heated, it loses this, and the silicate and metal are now found, on microscopic examination, uniformly diffused as an amorphous metallic paste, with a structure *pseudo reticular;* but if the bar be submitted to any of the following operations—

1. Tempering, or sudden change of temperature;
2. An unequal heating, or a weld in the direction of its length;
3. Successive blows; friction of all sorts;
4. Electric discharges;
5. The action of an electric current, or of a magnetic armature;
6. Leaving it to repose near the surface of the earth, and especially in a position perpendicular to the magnetic meridian.

Then the molecular structure suffers the following changes, according to the energy of these actions, and the temperature at which they act. The amorphous structure of the silicate, and the pseudo-reticular one of the iron cease; and we find following the axis of figure of the piece of iron, baccillary crystals of neutral silicate; these crystals present many easy cleavages, but principally at a small angle with the axis of the prism. In addition, the metallic portions are no longer equally diffused in the vitreous paste; they show a marked tendency to group themselves in bundles, following the axis of the poles of the crystals: thus, the metallic paste presents a phenomenon of crystallization, with pastiness analogous, up to a certain point, to the fact of the rhomboïdric crystallization of the sand-stone of Fontainebleau.

If we examine, after use, the structure of strained pieces, and especially of mail-coach axles, or those of large wagons, originally of fibrous iron, (*fer nerveux,*) we see at once, following the axis of figure in the middle and at the origin of the rounded parts, baccillary crystals of silicate, *empasting* the

fusiform parts of the metallic iron, grouped particularly parallel to their axis. Hence the phenomena of facetted structure which broken axles present, &c., &c.

To prevent this taking place, the author proposes—

1. To reduce, by a strong welding heat, with pit-coal, the relative quantity of vitreous paste, which, in ordinary iron, often is as much as ·007 of the total weight.

He proposes also to use for axles scrapped iron, ("*vieux fers et riblons.*")

2. To *struggle* against the forces which induce (*provoquent*) the prismatic and fusiform structure following the axis of the figure ! !
3. To destroy, as a last operation, every modification of molecular structure resulting from the working in the fire and under the hammer, by a simple reheating to a dull red heat, of which the immediate effect is, to reduce the vitreous mass to the amorphous state, and to re-establish the pseudo reticular structure in the metallic particles.

This last remedy can always be employed efficaciously to restore to their state of primitive solidity, pieces whose texture has been altered by use.

The foregoing is almost a translation of this document, which presents an admirable specimen of the talent in which Frenchmen are so peculiarly happy, of slurring over a difficulty, and raising a fog of hard and meaningless words about a subject which, while they do not understand, they will not admit their ignorance of.

All that can be gathered with any distinctness from this paper of M. François is matter known to every intelligent blacksmith in Britain, and probably in France too, although much of it has recently been brought before the public with much pretension to novelty, by Mr. Hood and Mr. Nasmith. It has long been well known, that violent change of external form given to iron, in whatever way, if below the temperature of a blood-red, makes it brittle, and also that its toughness may be fully restored by annealing, or heating up to the blood-red, and slowly cooling; but beyond this, or upon what this phenomenon depends, there is as yet no knowledge. Further, it is certain that this change cannot be produced by any change of form which is not permanent, *i. e.*, by any bending, or indenting, or vibration which is within the elastic limits of the material; and hence there does not seem to be any foundation whatever for the *assumption*, that railway or other axles change their interior structure while in use. Thus far it is clear that, as yet, no case has been brought forward of any axle or revolving shaft, or other such piece of iron, the structure of which has been found, when broken, to be crystalline, and of which it could with certainty be affirmed that it had ever been otherwise—had ever been fibrous; on the contrary, there is every reason to believe that the broken axles exhibited to the Mechanical Section of the British Association, at Manchester, &c., had never been in structure any thing else but crystalline, from the time when they were forged, and when this structure was conferred upon them by swaging until nearly cold.

Sudden change of temperature seems more or less to affect the state of arrangement of the particles of all metals, (as well as other bodies,) sometimes making them harder and denser, sometimes softer and less dense; but evidence is as yet wanting that magnetism is capable of producing the slightest effect of the sort, or electrical discharges or currents. On the contrary, as regards the latter, it is well known that when a hard iron pin, as it comes from the draw-plate, has been heated red-hot by a voltaic current, it becomes soft, just as if annealed in a common fire, and equally as tough. It will be observed that the grand recipe of M. François for curing this diseased iron consists in annealing it. This was well known before; but as the very same thing has since been proposed, with all the air of a new discovery, by Mr. Nasmith, in the Mechanical Section of the British Association, in June last, and since in the *Civil Engineer and Architect's Journal*, for September, it may be remarked that M. François' paper was published in Paris on the 30th of May last. The subject, if considered in a really scientific aspect, without the desire to hide our ignorance, or pretend to discovery, is one of great curiosity and some importance; and hence it has not been amiss that the British Association, at its last meeting, devoted a large sum of money to researches upon the question: but this money will be grievously wasted, and the time of the experimenters likewise, if squandered upon costly experi-

ments to find out whether railway axles, that have neither been bent nor overheated, suffer some change of structure by merely turning round in their bearings under their load.

3. A communication follows from M. Delessert, in which he gives an extract of a letter from Mr. Prevost, an officer on the London and Birmingham Railway, giving an account of the experiment made on that line by Mr. Bury and others, and intended to demonstrate the superiority of four-wheel engines, in which such an engine, with a broken axle, which had purposely been cut nearly through, was caused to travel some miles upon the railway, and ran off the rails; but, as a full account of this singularly ill-contrived and inconclusive experiment has already appeared in the pages of the *Mechanics' Magazine*, there is no need to repeat it here.

4. The next communication, however, is of more importance, and, as coming from M. Pambour, seems worthy of translation nearly complete: it is entitled "A note on the dispositions most suitable for diminishing the serious consequences of accidents on railways.

"As to the question of whether it is better to perform traffic with a single locomotive and a light train, or with two locomotives and a double train, we have stated that, when a train is drawn by two engines, if an accident occur to the first, about one-half the train will be involved in the accident, but that the remaining half will run no risk, but will be in the same condition as if it had been drawn separately by a second engine; and that if the accident happen to the second of the two engines, the accident, which would be disastrous if there were but one engine to the train, will not be followed by any ill result, because the broken engine, being preceded by the other, will be kept up and upon the line; hence, it is of advantage to employ two locomotives to a train.

"It is true that, if the accident happen to the second engine, it can be foreseen or provided against; but if the accident occur to the foremost one, it will be much more serious than if the train were separated into two, inasmuch as the shock will be twice as great, the weight of the train being twice as much; and so as was the case on the Versailles Railway, the carriages, pushed one by the other, become piled on top of each other, and simple blows become converted into dreadful wounds, without considering the fact, that on an embankment or a viaduct the whole train is destroyed, instead of only one-half, as when divided between two engines. Thus, the preceding argument in favour of trains with two engines would be of force, were it not that they produce, themselves, chances of accident which do not exist in the case of isolated engines.

"But we know that nothing is more dangerous than to *push* before us one or more carriages, because the action of pushing the carriages tends to give them a diagonal, or zig-zag motion upon the way. If we push a train with some velocity, there is great chance of one of the carriages going off the line; and this chance is greater in proportion as the train is longer and heavier, and the required force greater.

"Now, if two locomotives are attached together, it frequently happens that the second engine pushes the first, and its tender, before it. This contingency will arise whenever the fire is neglected in the first engine—whenever, on account of signals, the first engine-driver slacks his speed before the second is aware of it—whenever the first engine encounters rails badly laid, or a crossing, or enters on a curve, or passes from a declivity to a level, or thence to an acclivity —in all these cases it is clear that the foremost engine will be partially stopped, and will present an obstacle to that behind; and at these moments the former, with its tender, will be struck by the hinder engine, and pushed on before it: it is clear, therefore, that the connexion of two engines produces dangers which do not otherwise exist."

THE PARIS AND VERSAILLES RAILWAY ACCIDENT—NEW AND AUTHENTIC PARTICULARS.

Sir,—The accident of the 8th of May last, on the Paris and Versailles Left Bank Railway, having excited much discussion in the *Mechanics' Magazine* and other journals, both with reference to its cause and to the means of preventing such accidents in future, I will, with your permission, lay before your readers a few circumstances connected with the accident, some of which I collected on the spot, and others in Paris, which place I visited soon after the accident.

I am induced to do this, as much misunderstanding of the facts of the case has been shown to exist on the part of most of those who have written on the subject; and the discussion, as appears by your journal for August, is very likely to be continued for some time longer.

Soon after my arrival in Paris I visited the Left Bank Station, and saw the

remains of the two engines that were attached to the train to which the accident occurred. They were both small engines; the four-wheeler had 10 or 11 inches cylinders, and the six-wheeler 12 inch cylinders; the stroke in both, I believe, was 18 inches.

The four-wheel engine was destroyed, and the six-wheel engine would require new framing, and other expensive repairs. Both tenders were past repair; the fore and hind axles of the six-wheel engine and those of its tender were very much bent, most of which bending, probably, took place when the axles were very hot. The wheels appeared but little injured.

I learned at the station that the Left Bank Railway Company never had more than three four-wheel engines, and one of them, made by the late Mr. Hicks of Bolton, was employed as a stationary engine to turn the lathes and other machines used in the repairing-shop.

At the Right Bank Railway, I was informed that on that line there were six four-wheel engines, but they were considered so much more liable to accident than six-wheel engines, that none of them had been used on that railway for twelve or eighteen months before the accident occurred on the Left Bank Railway.

On arriving at the spot where the accident took place, and standing on the common road where it crosses the railway, the first thing that struck me on looking along the line in the direction of Versailles, was the very sinuous state of the right-hand rail, of the right line of rails; I immediately called the attention of a friend, (a very intelligent French engineer) who was with me, to the fact, when he informed me, that one of the engineers appointed by the Government to investigate the circumstances connected with the accident, had discovered that the four-wheel engine had gone off the rails, say one hundred to one hundred and fifty yards before arriving at the place where it turned over, and that the axles could not have been broken, or even much bent, until the engine nearly reached the place where it broke down.

The evidence which led to this conclusion, was this:—From the place where the engine ran off the rails, to where the common road crosses the rail-road, every alternate sleeper was indented on the left side of both rails by the wheels, and these indentations were at the same distance asunder as the flanches of the wheels were when in order, but those on each succeeding indented sleeper were further from the rails than those on the one preceding.

These facts indicate that the engine had oscillated laterally, and very likely vertically also, as this class of engines are liable to do, until it got off the rails, and that then its speed caused it to jump to such an extent as to make it pass from the first sleeper to the third, fifth, seventh, and so on, proceeding at each jump a distance of six feet; until at last the crank axle was fractured, and both ends of the front axle were broken off.

Much pains have been taken to make it appear that the breaking of the axle led to the accident, but from the foregoing statement, it is apparent that the breaking of the axles was a *consequence* of the engine jumping or getting off the rails; and it is surprising that the axles should have borne so much striking against the sleeper as they did before they broke.

Some attempts have been made to cause it to appear that the engine was thrown off the rails, by coming against the entrance to a crossing from one line of rails to the other, but that could not be the cause of the engine being thrown off, as it left the rails one hundred and fifty yards short of the crossing.

It is hardly conceivable that both ends of the front axle could be broken off, at the same time, by any ordinary running, however bad the iron might be; but the jumping from sleeper to sleeper is sufficient to account for the breaking of both axles.

When an accident occurred on the Eastern Counties Railway, the rails were bent for sixty yards. On this line two dreadful accidents have taken place without any other apparent cause than that which is attributable to the peculiar action of four-wheel engines.

Some persons have endeavoured to show that the accident on the Brighton Railway arose from the curvature of the rails at the part, where it occurred, and the bad state of the road from the giving way of the newly-formed embankment, in the face of the facts, that the road is straght, in a deep cutting in the part, and not on an embankment, and was in very good order.

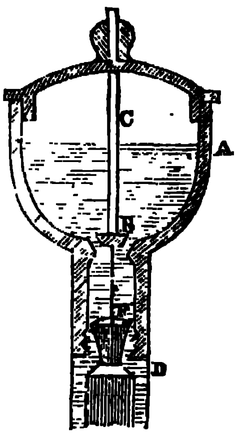
When the accident occurred on the

Brighton Railway, it will be remembered that the leading engine was one having only four wheels. But it may not be generally known, that on the day next preceding that on which the fatal accident happened, a four-wheel engine ran off the rails in a tunnel, and furrowed the wall for a considerable distance.

I am, Sir, your humble servant,

A PRACTICAL ENGINEER.

### LUBRICATORS.




Sir,—I was exceedingly pleased with Mr. Houghton's very ingenious Lubricator, described in No. 993 of your invaluable work; but there was one circumstance which I was not quite clear concerning, namely, whether the pressure of the atmosphere, when it closes the top valve, also forces the oil clear from the space between the valves? Or does the valve shut first, and the oil merely trickle out? If the atmospheric pressure sends the oil out with a spurt, I think it would send more out than what is contained between the two valves. I also think it would be an improvement to have a small strainer just above the bottom valve, with the holes so small that the oil would only pass through when under pressure, which would effectually prevent any impurities from entering the cylinder. I have prefixed a slight sketch of a plan which would strain the oil by pressure of the atmosphere, if Mr. Houghton's Lubricator should not do so.

A is the oil-cap; B, the top valve, with a small tube, C, communicating with the bottom of the valve, and working through the top of the oil-cup in the manner of a piston; D, the bottom valve; F, the strainer.

I am, Sir, yours truly,

DOUBT.

### THE BUDE AND BOCCIUS LIGHTS.*

*Report of Dr. A. Ure, F.R.S., Professor of Chemistry, Consulting and Analytical Chemist, &c. &c.*

I have carefully perused the specification of Mr. Gurney's patent, also the evidence taken before a Committee of the House of Commons on the advantages of his improvements in the lighting of that house, and I am of opinion, that the patent is perfectly good in law, as by this evidence it is clearly proved that artificial light is thus produced in greater quantities, and of a better quality, than by any other means heretofore known, and at a saving of 50 per cent. A material benefit is consequently conferred upon the public, and such as is intended to be protected by the statute, even if the patentee laid no claim to the novelty of any of the apparatus, or materials used.

This construction of the law has been borne out by many recent decisions, but more particularly in the case of Crane against Price and others, in which judgment was given last term. In this case an action was brought for an infringement of a patent obtained for improvements in the manufacture of iron, by using anthracite coal in combination with hot blast, neither of which were new, and both of which had been previously used for that purpose, though not in conjunction. The verdict was, nevertheless, for the plaintiff, and Chief Justice Tindal, in pronouncing judgment, observed, that "*if the result of a combination is either a new article, or a better article, or a cheaper article, to the public, than that produced by the old method, such a combination is an invention, or manufacture intended by the statute to be protected by a patent, even when the invention, or improvement, consisted in no more than the use of things already known, and acting with them in a manner already known, and producing ef-*

* Having already given the Report of Messrs. Brande and Parkes in favour of the Boccius Light—the intent of which Report, or at least of those who paid for it and first gave it publicity was to deceive the public into a belief that the Boccius Light is superior to the Bude and all others previously invented, we do but an act of equal justice to Mr. Gurney, in now laying before our readers the opinion which Dr. Ure, a most competent authority, has at Mr. G.'s instance given on the subject. We are glad to find, that so far as regards the Charing-cross phenomenon, Dr. Ure's opinion is perfectly in accordance with that which we had ourselves previously expressed.—ED. M. M.

*fects already known, but producing those effects, so as to be more economically, or beneficially enjoyed by the public."*

Now it appears to me that the law as thus laid down, and recognised by the judges, is equally applicable to Mr. Gurney's combination of materials for the production of light, even admitting that there were no novelty in those materials, the result (which is the material point at issue,) being the production of an article of commerce, which is more beneficially enjoyed by the public, as proved in so satisfactory a manner by the Report of this Parliamentary Committee before which I was myself examined.

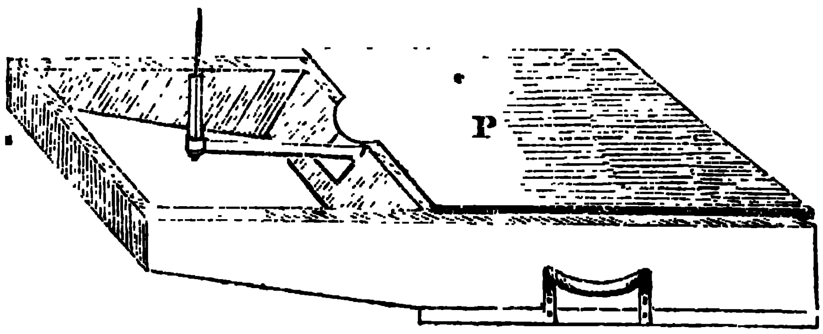
I have inspected, also, the drawings and specification of the patent obtained by Gottlieb Boccius, and I have likewise examined the light recently erected opposite Northumberland House, in the Strand, known as the "Boccius Light," and I have no hesitation in pronouncing it to be a manifest piracy and barefaced imitation of Mr. Gurney's patent.

Having been originally consulted on the case of the Queen *v.* Bynner, whose patent for what is termed the "*Solar Lamp*" was recently repealed by a *scire facias*, as defective, false, &c., I am of opinion that, if a similar course was pursued with respect to the Boccius patent, a similar result would follow.

(Signed) ANDREW URE.

13, Charlotte-street, Bedford-square.
October 4, 1842.

## MAYNARD'S COAL-WEIGHING MACHINE.




Sir,—In answer to the enquiry of a wharfinger in your 998th Number, I herewith enclose a rough sketch of a weighing machine manufactured by Mr. Robert Maynard, of Whittlesford, near Cambridge, and in common use by the merchants of this town for coals, &c.

It consists of a wooden box or frame, containing the levers, supporting by four steel centres the corners of the platform P. The levers are connected in the interior of the box, in such a manner, that a load placed on any part of the platform has an equal tendency to raise the end of one of the levers, which is elongated, and terminates with a pin fitting a hole in the centre of each weight. The weights are flat; the two largest weigh exactly 7 lbs. each, and both together balance 2 cwt. on the platform. The whole is extremely portable, weighing about 50 or 60 lbs.; size of platform 18 inches by 15; height from floor 6 inches.

We have several of them in daily use; they cost us 2*l.* 6*s.* each.

I am, Sir, yours, &c.,

CHARLES FINCH FOSTER.

Cambridge, October 3, 1842.

## ELECTRO-MAGNETIC RAILWAY LOCOMOTIVE.

(From the Edinburgh Evening Journal.)

A trial of this very ingenious machine, constructed by Mr. Davidson, was made on Thursday on the Edinburgh and Glasgow Railway, in presence of a number of gentlemen, many of whom were eminent for their scientific knowledge. The construction of the carriage is the first attempt which has been made in this country to apply the powers of electro-magnetism to railway traffic, and from the success which attended this trial sanguine hopes may be entertained that the period is not distant when it will

either supersede, in many cases, the employment of steam, or lend a powerful aid to this mighty instrument in all the operations in which it is at present employed. The carriage was impelled along the railway about a mile and a half, and travelled at the rate of upwards of four miles an hour, a rate which might be increased by giving greater power to the batteries, and enlarging the diameter of the wheels. We understand that the carriage was built at the expense of the Railway Company, and we cannot but congratulate them in having the discernment to employ Mr. Davidson, a gentleman of much practical knowledge and talent, to whose genius great discoveries have been made in electro-magnetism, by whom the carriage was projected, and to whose unwearied exertions the practicability of the scheme is almost placed beyond a doubt.

The dimensions of the carriage are 16 feet long by 7 feet wide, and is propelled by eight powerful electro-magnets. The carriage is supported by four wheels of 3 feet diameter. On each of the two axles there is a wooden cylinder, on which are fastened three bars of iron at equal distances from each other, and extending from end to end of the cylinder. On each side of the cylinder, and resting on the carriage, there are two powerful electro-magnets. When the first bar on the cylinder has passed the faces of two of these magnets, the current of galvanism is then let on to the other two magnets. They immediately pull the second bar until it comes opposite them. The current is then cut off from these two magnets, and is let on to the other two. Again they pull the third bar until it comes opposite, and so on—the current of galvanism being always cut off from the one pair of magnets when it is let on to the other.

The manner in which the current is cut off and let on is simply thus:—At each end of the axles there is a small wooden cylinder, one-half of which is covered by a hoop of copper; the other is divided alternately with copper and wood (three parts of wood and three of copper.) One end of the coil of wire which surrounds the four electro-magnets, presses on one of these cylinders, on the part which is divided with copper and wood; the other end of the coil presses on the other cylinder in the same manner. One end of the wires or conductors which comes from the battery, presses constantly on the undivided part of the copper on each cylinder. When one of the iron bars on the wooden cylinder has passed the faces of two magnets, the current of galvanism is let on to the other two magnets, by one end of the coil which surrounds the magnets, passing from the wood to the copper, and thereby forming a connexion with the battery. This wire continues to press on the copper until the iron bar has come opposite the faces of the two magnets, which were thus charged with galvanism. On its coming into that position, the current is cut off from these two magnets, by the wire or rod of copper passing from the copper to the wood, and thereby breaking the connexion with the battery. But when the wire or rod of copper leaves the copper on the one cylinder, it leaves the wood, and passes to the copper on the other cylinder at the other end of the axle, and in so doing connects the other two magnets with the battery, and they pull the next iron bar in the same manner. At the other end of the carriage there are other four magnets, and wooden cylinder, with iron bars arranged in the same manner.

The battery which is used for propelling the machine is composed of iron and zinc plates immersed in dilute sulphuric acid, the iron plates being fluted so as to expose greater surface in the same space. The weight propelled was about six tons.

[We are glad to see that the value of the electro-magnetic agency, as a moving power, is at length likely to have a fair trial. The plan of Mr. Davidson is precisely the same as that of Captain Taylor, described in vol. xxxii. page 694; but it will no doubt be in the recollection of our readers, that Mr. Davidson claims to have adopted that plan before it was patented by Captain Taylor. See *Mech. Mag.* vol. 33, pp. 53, 92.—Ed. M. M.]

## INSTITUTION OF CIVIL ENGINEERS.

June 28, 1842.

"*An Account of the Bridge over the Thames, at Kingston, Surrey.*" *By John Brannis Birch, Grad. Inst. C.E.*

Previous to the year 1828, when the present bridge was opened to the public, the communication between the town of Kingston-upon-Thames in Surrey, and the hamlet of Hampton-wick in Middlesex, was carried on by an old and incommodious wooden bridge, which was so dilapidated that any attempt to put it into a substantial condition for the service of the public, would have been equivalent to an entire rebuilding of the structure.

The corporation of Kingston, therefore, resolved upon erecting a new bridge, on a design by Mr. Lapidge, their architect, and in the year 1825 obtained an Act of Parliament, granting them the powers necessary for that purpose.

The trustees appointed under the Act applied to the Exchequer Bill Loan Commis-

sioners for pecuniary assistance to the amount of £45,000, but the application was not entertained until the working drawings, specification, &c. had been submitted to their engineer,—the late Mr. Telford, when he gave the following opinion :—"Having carefully inspected all the working drawings, I consider it only justice to Mr. Lapidge to say, that they are very complete and do credit to his judgment and assiduity; and as the blue clay has been found quite across the bed of the river, I am of opinion that, with the precautions provided in the working drawings and specification, the work is very practicable, and if well executed will prove a substantial and useful edifice." He also said, "I have gone through the detailed estimates, and compared the same with the proposal accepted by the corporation, and am satisfied that the works may be properly executed for the sum therein mentioned, viz., £31,300;" and he stated "the amount of the general estimate including the above sum—the expenses of houses and ground—the flood-arches and roads of approach, &c. to be £47,457."

Upon receipt of this report, the Commissioners consented to make the required loan, but it being found that the Act limited the amount to be raised to £40,000, alterations in the structure were suggested by Mr. Lapidge, which received Mr. Telford's approval, and the works were commenced on the reduced scale.

The bridge is of Grecian architecture and consists of five elliptical arches; it is constructed chiefly of brick, with ashlar facing. The abutments are terminated by towers, and the structure is surmounted by a cornice and balustrade, with galleries projecting over the piers. The span of the centre arch is 60 feet, with a versed sine of 19 feet; the side arches are 56 feet and 52 feet span, and 18 feet 3 inches and 16 feet 6 inches rise, respectively. The highest flood rises 6 feet above the springing line, and the lowest summer level is about the same distance below it. The foundations are all laid upon the substratum of blue clay. The length of the bridge is 382 feet to the extremes of the abutments, and the width between the balustrades is 25 feet. The proportion of the piers to the span of the arches is about ⅓th. The roadway is formed at an inclination of 1 in 40.

The author then describes fully the construction of the abutments, piers, arches, and the superstructure. The work occupied about 2¾ years to the completion, the first stone having been laid on the 7th of November, 1825, and the bridge opened in form on the 17th of July, 1828.

On the completion, Mr. Telford again made a report to the Exchequer Bill Loan Commissioners in these terms:—"With Mr. Lapidge, I examined the whole of the bridge and approaches, and taking it for granted that the foundations of the piers and abutments, which are under water, and which I had no opportunity of inspecting while in progress, are according to the working drawings, all the other parts are found in a very perfect state, executed in a workman-like manner."

The bridge has in every respect answered the object for which it was intended, and it has justified the good opinion Mr. Telford originally formed of it.

During the fourteen years which have elapsed since its erection, it has required none other than the most trifling repairs, and the expectations of the trustees have been realized by the tolls having paid the allotted portion of the principal, up to the present time, as well as the interest of the money borrowed for its execution, and the cost of it did not exceed the amount of the estimate.

The communication was accompanied by seven remarkably well-executed drawings, showing accurately all the details of the construction, and the Paper contained all the quantities of materials in the work, together with Mr. Telford's reports upon it, with other documents of interest.

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"*Description of the Harbour of Port Talbot (Glamorganshire).*" *By Henry Robinson Palmer, V. P. Inst. C. E.*

The harbour described in this communication is situated upon the outfall of the river Avon, on the eastern shore of Swansea Bay. The adjacent mountainous district terminates abruptly at about half a mile from the shore, in a tract of marshy land, for the most part composed of sand, with detached beds of clay and peat of various thickness, at about 10 feet below the surface.

The river, which, at its issue from its rocky channel, had been diverted from its course by accumulations of sand, nearly at right angles with its point of discharge into the sea, would appear at some period to have had a direct channel thither. It has been the object of the author, by whom the works were designed and executed, to restore this obvious course for the land water, and by means of embankments, to convert into a dock that portion of the old channel which extends through the marshes. A new channel has also been formed from the outfall to a convenient part of the dock, with a lock 45 feet in width for the passage of vessels.

As the works were undertaken by a few private individuals, every proper economy

was enjoined; and in order to diminish the expense of excavating by manual labour a channel of 100 feet wide and a mile in length, Mr. John Vigurs (whose extensive tin-plate and copper works are situated in the adjoining valley) proposed that the new channel should be formed by the force of the land floods, which descend with great impetuosity. A trench of 20 feet wide by 10 feet deep, was therefore cut in the line of the proposed channel; and a few days after it was finished, a heavy land flood descending from the mountains rushed through it, carrying out to sea from the sides and bottom of the trench an immense quantity of the soil. Every succeeding flood increased the size of the trench, and by judicious guidance of this natural excavator, the channel was formed of the requisite dimensions; and it is now generally kept clear from accumulation by the land floods, but in dry seasons by the sluices in the lock-gates. The bed of the channel is stated to form a regular inclined plane of more than a mile in length, free from a shoal or any other impediment.

The confluence of the two channels has been rendered permanent, by a pier of copper slag, with an active slope of five to one. When finished, this pier will extend full half a mile in length.

The paper then describes generally the ordinary modes of construction adopted in the works, and more particularly the lock, the cill of which is 23 feet below the level of an ordinary spring tide: the coping is 2 feet above that level, and the gates are 25 feet 6 inches high.

The fabric of the lock is composed of hard silicious sandstone, cemented with blue lias lime mortar. The ashlar work of the walls is 4 feet in thickness, with counterforts, and the spaces between them are filled with rubble, grouted with lime and sand. The whole thickness of the walls may therefore be taken at 8 feet, excepting at their bases, where they are 10 feet. The walls rest in part upon an inverted arch, three feet in thickness, and the whole mass, including the invert, rests upon a concrete of large and small rubble.

The harbour is stated to be in immediate connexion with extensive copper and tin-plate works, and also with a great extent of coal-beds bordering the valley of the Avon, and the trade is rapidly increasing, its position in the Bristol Channel being highly favourable to a foreign trade.

A plan of the harbour, with the streams and channels, and a transverse section of the lock accompanied the paper.

## THE WATER QUESTION — UNFILTERED WATER DELETERIOUS TO HEALTH AND DESTRUCTIVE TO LIFE.

Sir,—I propose to prove,

*First, that impure water is injurious to health and life;* and,

*Secondly, that the water, particularly, supplied by the water monopolies of London is impure,* and, at the present season, from *the fall and decomposition of vegetable matter, a primary cause of the augmenting mortality of the metropolis.*

First. To prove this department of my case, I call—

*Hippocrates*, the Father of Medicine, who says, "To distinguish *that* water which is wholesome is of the *first* importance to health, for *a train of evils are the consequence of the use of bad water.*"

*Dr. Griffiths.*—"With regard to the water in use, we cannot be too scrupulous; the purity of this element being almost of equal importance to us with *the air we breathe.*"

*Dr. F. Hoffman.*—"If every physician would make it his practice carefully to examine into *the quality of the water* used in the houses he visits, he might confidently hope to practise with more benefit to his patients."

*Dr. Mead*, after speaking of poisonous exhalations and airs, observes, that impure water "must be necessarily almost equally *fatal and dangerous.*" He adds, "a late authority, by searching into the first accounts of the scurvy, finds that the origin of it was, *in all times and places, charged upon the use of unwholesome water.*"

*Dr. Lind* ascribes the scurvy (*inter alia*) to those "*who are obliged to drink unwholesome water.*"

*Dr. Harrison.*—"The dry rot in sheep has its cause in *the poisonous residuum of water.* A flock of sheep will rot in one day; or, on some water meadows, when the weather is sultry, in half an hour."

*M. Cabanis.*—"Water loaded with putrid vegetable matters, or with earthy substances, *acts in a very pernicious manner on the stomach*, and the other organs of digestion; producing different kinds of diseases, both acute and chronical * * * they blunt the sensibility, enervate the muscular force, and *dispose to all cold and slow diseases.*"

*Dr. W. Lambe.*—"It is the putrescent matter which is the most noxious principle of common water * * * *sometimes the stomach feels as if it would burst;* sometimes the sensation is, *as if a cord were tied round the middle of the body.*" * * * "The peculiar noxious principle of bad water is nothing but the corrupted animal and vegetable matters with which they are

impregnated; *these matters are, therefore, poisonous.*"

(What must the water be into which the common sewers of upwards of a million of human beings pour their filth daily?)

*Dr. Ure.*—"It cannot but be an interesting object to ascertain the *component parts and qualities of the water* daily consumed by the inhabitants of large cities. A *very minute portion of unwholesome water, daily taken,* may constitute the principal cause of the differences in salubrity which are observable in different places."

*Mr. Abernethy.*—"Diseases have been excited by water, and therefore *it is necessary that whatever is used should be as pure as possible.*"

*Sir Henry Halford and Lord Wharncliffe.*—"A constant supply of *pure and wholesome water is essential to the health* and comfort of the inhabitants of this great and thickly-peopled metropolis."

I trust the above witnesses will be held sufficient to establish my first proposition; and I now, therefore, proceed to my second, in order to fasten these evils upon the right shoulders, to wit, the water monopolists of London.

*Dr. James Johnson.*—Question—"Have you, in your practice, met with any injurious effects from the use of Thames water?"

Answer—"Yes; I was informed by Mr. Ibell, Waterloo-place, who has a great many young women employed in the millinery business, that several of the young people have been repeatedly affected with bowel complaints; but that if they went out of town a few days, and drank other water, the complaint subsided, but often returned again on their again drinking this water. I am the medical attendant on this establishment."

*Mr. William Ibell.*—"Have you reason to think that the health of any of your family has been injured by the use of this water? Most assuredly. In what way? Rather progressively. I employ a number of females in my business, who are from the country, and they are frequently affected, and also my family in general; they appear at first pallid, and then headache comes on, and they become affected in their bowels; I have had seven or eight at a time thus affected; when it has been so for two or three days, I then change the water to pump water, and in less than three days the effect is gone. It was the same when I resided in the city, and there it was I first discovered the cause to be in the water; and at that time I used the New River water. So that the same proportion of effect was produced from the use of the New River water, as from the use of the Thames water? Yes, nearly so; but the water of the New River is not so full of fibres as that of the Thames.

*Sir John Hall.*—"Have you any observation to make on the state of the water?" (St. Katharine's Docks.)

"I came to the docks, and found the water very impure, and could not use it: the clothes that were washed in it were dyed, and made of a bad colour."

"Can you use it for culinary purposes?"

"No; not without filtering."

*Dr. Paris.*—"My opinion, as a physician, is, that the water (Thames water) *is injurious to health.* I visited a family who were all ill, in the autumn, and I believe *their illness arose from drinking the water* on coming to town; *they changed the water, and drank other water, and got well.*" * * * "As a physician, who has devoted much attention to the subject, I cannot find terms sufficiently expressive of the *awful effects* it may be likely to produce upon the *health, and even lives* of the inhabitants."

*Dr. Yeates.*—"I should say of this water, that it is not wholesome: *I mean the observation to apply to any Thames water in and about London.*"

*Dr. W. Somerville.*—"It seems to me that the question of the purity of the water has been placed on a very erroneous footing by many, who say that there *is no ingredient in the water in London to produce disease: this reasoning would equally apply to water taken from the pan of a water-closet.*"

*Dr. Hooper.*—"The daily use of impure water (speaking of the water supplied by one of the Companies) *has a tendency to produce or is the cause of many diseases,* and it is a question of much importance whether such matters in the stomach do not greatly contribute to the production of that state of faulty digestion and impurity of blood, of which the inhabitants of *this* and other large cities are constantly complaining."

*Mr. Keate.*—"By the aid of *filtering machines,* and a steam kitchen, I endeavour to avert from my family the *mischiefs and dangers* which I should otherwise apprehend from the use of the *sad compound* (Thames water) which is laid into my house."

The *Medico-Chirurgical Review,* vol. iv. p. 207.—"A time *must* come when *the people of London will open their eyes to this scene of corruption,* veiled and concealed as it is by iron tubes and stone pavements. We are not among the idolaters of the ancients; but we do admire the delicacy of their taste, in expending so much labour and wealth in commanding abundant supplies of pure and salubrious water for the 'Everlasting City.'"

*Mr. William Clapp.*—"All sorts of impurities are found in the Thames water; in my opinion as a professional man, the water

is decidedly impure and injurious; *hurtful in the extreme.*"

*The Royal Commissioners, Dr. Roget, W. T. Brande, and Thomas Telford.*—"We have endeavoured to gain information from various sources, respecting the state and purity of the Thames water, and its general fitness for domestic use; and from such inquiries it appears proved to us, that the quality of the water within certain limits, included in what may be called the London district, has suffered a gradual deterioration within the last ten or twelve years. We found this opinion upon the well-ascertained fact of the disappearance of fish from those parts of the river, to such an extent as to have led to the almost entire destruction of the fisherman's trade between Putney Bridge and Greenwich; and upon the circumstance that the eels imported from Holland can now with great difficulty *be kept alive* in those parts of the Thames where they were formerly preserved in perfect health. We also learn that the fishmongers in London find *it impossible to preserve live fish for any length of time in water from the same district.*"

*Dr. Bostock.*—"It appears that the water of the Thames, as it approaches the metropolis, becomes loaded with a quantity of filth which renders it *disgusting to the senses, and improper to be employed in the preparation of food.*" * * * "Two bottles were sent to me for inspection, one containing the water of the Thames, the other containing water taken from the same source *after having been filtered*: the former exhibited the *usual* appearance, while *the latter was perfectly free from visible impurities*, and had lost all unpleasant flavour or odour. I think, therefore, we may conclude that *the process of filtration, if properly conducted, would be in all respects unexceptionable*, provided a sufficient quantity of water could be procured by this means for the supply of the metropolis."

Surely it is unnecessary to crowd your columns with additional proofs of my second position, hence I shall not make extracts from the evidence of Dr. Brodie, Dr. Turner, Dr. Hume, Dr. Macmichael, Dr. Bree, Mr. Thomas, the President of the College of Surgeons, &c. I have struck out many unnecessary words in the extracts I have given, in order to save the space of your Journal, and the time of your readers. I therefore conclude with the following, not impertinent inquiry: Why is it that in the increasing mortality which the recent weekly bills exhibit, the remedy Dr. Bostock suggests, and which it was stated in the House of Lords, could be at once supplied, is not called for by the unanimous voice of the various organs of public opinion?

I have the honour to be, Sir,
Your obedient servant,
B.

Grafton street, Sept. 26, 1812.

ABSTRACTS OF SPECIFICATIONS OF ENGLISH PATENTS RECENTLY ENROLLED.

THOMAS RUSSELL CRAMPTON, OF SOUTHWARK-SQUARE, ENGINEER, AND JOHN COOPE HADDAN, OF LIVERPOOL-STREET, SAINT PANCRAS, CIVIL ENGINEERS, *for certain improvements in steam-engines and railway carriages.* Patent dated, February 15, 1842.

These improvements comprise, first, an improved method of reversing, and varying or altering the cut off of the steam, by varying the position or inclination of one eccentric rod to each cylinder of locomotive, stationary, and marine steam-engines; second, an improved method of altering the lead of admission, by giving various inclinations to the valve-rods of locomotive, stationary, and marine steam-engines; third, an improved method of cutting off and of varying the lead of admission, (without increasing or diminishing the traverse of the slide-valve,) by varying the inclinations of the eccentric rods of locomotive steam-engines: fourth, a method of diminishing the friction of the slide-valves of locomotive, stationary, and marine steam-engines, by the application of improved pistons to such slide-valves; fifth, an improved method of regulating or altering the admission of steam, in its passage from the slide-valve box to the inside of the cylinder of locomotive, stationary, and marine steam-engines, independent of the action of the slide-valves; sixth, an improved method of using steam expansively in locomotive steam-engines, by increasing the size of the cylinder, and applying a regulator, or throttle-valve, to each cylinder; seventh, a method of lowering the centre of gravity of locomotive steam-engines, by improved arrangements and combinations of the various parts; eighth, an improved method of constructing the tubular boilers of locomotive steam-engines, by lowering the position of the tubes, and applying a bridge across the fire-box; ninth, the application to locomotive steam-engines and railway carriages of cylindrical wheels, with outside flanches fitted to axles which will allow each wheel to run independent of the other; tenth, the affording additional security to locomotive steam-engines, by the addition thereto of extra (safety) wheels or sledges; eleventh, the application to railway carriages of springs

formed by levers acting upon and twisting bars or tubes of steel; twelfth, the application to railway carriages and locomotive steam-engines of wheels with felloes of wood, papier machée, or other suitable material, tightened by a bevelled ring or circular wedge; thirteen, the application to railway carriages and locomotive steam-engines of wheels formed with wooden felloes, simultaneously compressed by being forced through a conical ring, or by means of an improved arrangement of screws or hydraulic presses. The details of each of these several improvements are very minutely described, and illustrated by numerous drawings.

*Claim.*—"We claim the several improvements enumerated and described, and their use, either separately or when combined with each other; but we make no claim to such old and well-known means as may have been incidentally mentioned or referred to."

The "old and well-known means" ought to have been particularly distinguished from the new, that the public might know what they are at liberty to use without the license of the patentees, and what not.

ALEXANDER ROUSSEAU, OF THE STRAND, MANUFACTURER, *for certain improvements in fire-arms.* (A communication from a foreigner residing abroad.) February 15, 1842.

Every time the gun is cocked, the action of cocking brings round on the nipple a detonating cap, ready for the hammer to strike upon.

A good idea, and well carried out.

JOHN BIRKBY, OF UPPER RAWFIELDS, CARD MANUFACTURER, *for improvements in the manufacture of wire cards.* February 25, 1842.

Of these "improvements," one consists in passing the teeth through a thin metal plate attached to the face of the back of the card, and thereby keeping them more regularly apart; a second, in making the backs of paper or pasteboard; and a third, in making the wires stronger, by making them longer, but bent into a zig-zag or spiral form in the stem, or at the crown.

The object of all the recent improvements in cards has been, to make them as *pliable* as possible; and hence the introduction of caoutchouc backs, which has been the subject of so much expensive litigation. The first and second of the present improvements are improvements in a retrograde direction; the third presents the likelihood of considerable utility.

BENJAMIN GILLOTT, OF GREAT SAFFRON-HILL, CUTLER, *for improvements in heating and ventilating.* February 26, 1842.

If the heated air is required to be suitable for respiration, it is to be forced through a reservoir of water; if otherwise, through a chamber filled with hot metal plates. The forcing apparatus, in both cases, is a fanner of the ordinary construction.

An open vessel of water placed on the top of a close stove, or in an apartment heated by pipes, will produce the requisite moisture, in a much more effectual manner than that now proposed. For the obtaining of dry hot air, the hot metal plate apparatus is an evident superfluity.

WILLIAM HANCOCK, JUN., OF AMWELL-STREET, *for certain improvements in combs and brushes.* March 21, 1842.

The "improvements in combs" relate to that class of combs which are employed in grooming horses, commonly called curry-combs, and consist in making the backs or stocks thereof flexible, instead of stiff, and unyielding as heretofore. This is effected by taking a piece of wire card (such as is used for carding machines) of the required shape, and doing over the back of it with two or three coats of a solution of caoutchouc, or any other strong flexible cement, (but preferring the former) and when it is in a sticky state, laying on a piece of leather, or felt, or thin veneer of wood, (to the underside of which has been given a coating of the same solution, and while that coating is also in a sticky state,) and pressing the whole together. When the cement has settled and the junction of the parts of which the back is thus composed is complete, there is inserted, for greater security, a number of small pins all round the edges, or the edges are sewn together with wire or strong thread.

The "improvements in brushes" are of two sorts, one relating to those descriptions of brushes which are chiefly employed in what may be termed dry brushing, as hair brushes, clothes brushes, horse brushes, machine brushes, &c., and the other relating to brushes employed for painting, colouring, varnishing, white-washing, plastering and other like purposes.

With respect to the class of brushes chiefly employed in dry brushing, the improvements consist principally in making the backs like those of the currycombs, flexible, instead of stiff, and unyielding as heretofore, or in making the brushes of a circular or other curvilineal form by fixing the bristles, or hairs in a flexible back, formed in manner after mentioned, and then attaching that flexible back to a solid back, made of the particular curvilineal form desired. When the whole of the back is to be made permanently flexible, the mode of proceeding is the same generally as that before specified with respect to the flexible backs for curry-combs; only that in the case of hair and

other brushes, to which it is desirable to give as much springiness as possible, a thin piece of metal, or whalebone, or horn, is inserted between the under and top pieces of the back, or the top piece is made to diminish gradually in thickness from the handle to the outer extremity. In making brushes of a circular, or other curvilineal form, the solid back may be either of wood, or metal, or any other sufficiently strong substance. If the brush is of the sort called a wheel brush, the solid disk should have a groove cut out all round its periphery for the reception of the flexible back, which may be composed of leather, canvass, felt, or other firm but yielding substance, and have the bristles, or hairs attached to it, by the usual method of drawing; or if it is a cylindrical brush, the solid cylinder should have a spiral groove cut out on its external surface, with such distances between the threads, that when the flexible belt of bristles or hairs is wound round it, the whole surface of the cylinder may be equally covered with the bristles or hairs. And in every case, whether the brush is of the wheel or cylindrical, or any other curvilineal form, the patentee recommends, that grooves should be made in the solid back for the reception of the flexible back, as being a more secure mode than any other of connecting the two together. The flexible back may be secured in the grooves, either by any suitable cement, or by nails or pins, or screws. It is sometimes of importance to be able to expand brushes, or parts of brushes when inserted in particular situations, as boilers, flues, cannon, &c.; and under circumstances which cannot be met by any determinate form, or any degree of flexibility which can be previously given to the brushes; and to provide for such cases, Mr. Hancock attaches to the under piece of the back of a flexible backed brush, or to the part or parts of the back requiring to be occasionally expanded, a piece, or pieces of sheet caoutchouc, or of cotton varnished with a solution of caoutchouc, by uniting the edges of such piece or pieces to the back, in such manner, that the included space, or spaces, shall be air-tight, (at least sufficiently so for practical purposes,) and then connects the included space or spaces, with a tube or tubes, leading to a screw-plug, in the handle of the brush, by opening and introducing air through which the brush can be inflated, either wholly, or in parts only, according to the arrangements made for the purpose. Where there are two or more parts of the brush having such distinct tubular communications with the screw-plug in the handle, there must, of course, be separate stop-cocks to each. Other brushes there are, which have habitually, or occasionally to be used in water, as bath brushes, hatters' brushes, &c., and to protect these from being loosened by the water, the patentee attaches to the under side of the flexible backs, before drawing the hairs, or bristles, a piece of India-rubber waterproof cloth, and that by means of a solution of caoutchouc, or any other efficient cement. It sometimes happens that the flexure required to be given to a brush when using it, is in a direction opposite to that which results from pressing the face of a flexible backed brush against any other body, that is to say, inwards, instead of outwards, and when a brush of this sort is required, the patentee constructs it in the following manner: To the two ends of a solid and slightly arched back of wood, or other sufficiently strong substance, he attaches a second back, which is flexible, and has the bristles, or hairs fixed in it, (exactly after the manner of the cord of a bow,) so that when the face of the brush is pressed against anything, the yielding takes place upwards, or outwards towards the solid arched back of wood.

The specification of the improvements in that class of brushes which are employed for painting, colouring, varnishing, white-washing, plastering, and other like purposes, is introduced by the observation, that brushes most commonly used for these purposes, (the plastering excepted,) are made of a round form, and with wooden handles, round which the hairs or bristles are secured by string; and that, in consequence of the liability of the wood to contract and expand, according to the degrees of heat and moisture to which it is exposed, the hairs or bristles become frequently loose and drop out, and brushes which in a cold or temperate climate are perfectly tight and sound, fall to pieces when exported to hot and warm climates. The improvements, therefore, consist in so constructing all such brushes, that the handle and brush shall remain firmly fastened together under all variations of temperature, and whether exposed or not exposed to wet and damp, that is to say, in so far as such fastening depends on the mechanical construction of the articles. With this view, the patentee constructs his brush, (a capital article,) as follows. He inserts the knot of hairs or bristles, of which the brush is to be formed, into a round socket of tin, and then passes a taper ferule, also of tin, down the centre of the knot of hairs or bristles, and through an orifice in the centre of the socket, taking care so to proportion the quantity of hairs or bristles in the knot to the dimensions of the socket and ferule, that when the ferule has been pressed down as far as it will go, the ends of the surrounding hairs or bristles will be so firmly compressed

between the socket and ferule, as to require no farther fastening. A taper handle, which may be either of wood or metal, fits into the ferule, and can be detached from the brush when not in use. The socket and ferule should be externally soldered together at the orifice in the socket; and for the sake of greater security in the case of brushes of a large diameter, the ends of the hairs or bristles, besides being compressed laterally between the ferule and socket, may also be imbedded or set in pitch, or other suitable cement, according to the ordinary pan method of construction.

## NOTES AND NOTICES.

*Iron Vessels.*—There are now in the iron ship-building-yard of Mr. John Laird, of North Birkenhead, two vessels of rather singular construction. The first vessel is intended for a floating-light for the entrance of the Mersey. It is much longer than the present light-ships, and is expected to have less motion, even in a rough sea, than the short wood vessels now in use. It will be ready for sea in about two months. The second vessel is building for the Hon. the East India Company; it is intended for a pilot-boat in the Hooghly. Unlike our pilot-boats, which are small, it is of 200 tons burden, and of more than ordinary breadth of beam. Its interior is to be completely finished in Liverpool. In the hold will be large tanks for holding water with which, it appears, the pilot-boats on the Calcutta station always go to sea, that, in the event of falling in with ships short of water, they may supply them with so indispensable an article. The cabin will be a spacious apartment, lofty and well ventilated, with berths all round for the pilots. We need scarcely add, after the heading of this paragraph, that, except the decks and the cabins, these vessels are wholly built of iron. They are well worth the inspection of all who take an interest in naval architecture.—*Liverpool Albion.*

*Blasting by Galvanism.*—The following is an extract from the letter of a Dunbar correspondent of the *Edinburgh Evening Courant*, dated September 19.—" Mr. Lyon, of Glasgow, the contractor for the new harbour here, has lately introduced that wonderful agent, the galvanic battery, to aid him in his extensive blasting operations. Several explosions of considerable magnitude have recently taken place. The largest contained 60 lbs. of powder, distributed in five bores of great depth. The bores were placed so as mutually to assist each other, and the conducting wires so arranged, that the whole five were fired simultaneously by one battery. It was expected that by this method the effect would be much greater than exploding the shots singly, and the almost incredible quantity of rock thrown down showed the correctness of the anticipation. In another instance, in order to throw down a part of the celebrated Castle of Dunbar, three bores (15 feet in depth) were run obliquely into the rock below the foundation. They were exploded together, and lifted from its bed, in one unbroken and compact mass, a body of masonry weighing not less than 150 tons. These experiments have been conducted by Mr. Robert Thomson, a young engineer in Mr. Lyon's employment."

*Caoutchouc Canvass.*—M. Vallé, a colour-maker, observing the injury caused to the works of some of the greatest masters by the influence of the atmosphere upon the canvass, has invented a solution (said to be of caoutchouc) which, although applied to both sides of the canvass, leaves it sufficiently elastic to prevent cracking, and secures it against the action of the atmosphere. To this he adds a peculiar kind of varnish for the painting, which is said to defy the ravages of time.

*Miniature Padlock.*—Messrs. Chubb and Son have just completed a most extraordinary piece of minute workmanship. It consists of an extremely small detector padlock made of gold, and weighing only 17¼ grains, but containing all the ordinary mechanism, and even the detecting apparatus of a complete lock. This miniature specimen of the locksmith's art is set in a ring not larger than those in ordinary use, and the proportions are so minute that, except upon close inspection, the skill which has been expended upon it would escape observation. The *Times* observer of this prodigy of art, " it seems only a subject of regret that so much ingenuity should have been expended in producing a perfectly useless toy." In the justice of this remark we entirely concur.

*Tunneling.*—The tunnel on the line of the Sheffield and Manchester Railway will be three miles in length, upwards of 600 feet below the surface or summit of the hill at its greatest height, and in rock formation throughout its entire length. The works were projected and commenced upwards of two years ago, under the direction of Charles Vignoles, Esq. Five shafts were opened, at about half a mile distant from each other, for the purpose of proving the formation, of facilitating the driving of the drift-ways, and ultimately, of ventilating the tunnel. Whilst these were in progress, the drift-ways were carried on from each side, or face, of the mountain; the distance, or length, driven, on the eastern side, extending to nearly 1,000 yards, and from the next shaft 180 yards. The junction between these two portions of the drift-way was effected on the 17th Sept., and the levels, when checked, on a tie-bench, at the point of meeting, had varied but nine decimals, or one inch nearly, and the range was within less than two inches of being geometrically true. When it is considered that this has been attained whilst driving upwards of half a mile through hard rock formation, it must be admitted to be highly creditable to the parties engaged in directing it.—*Dub. Even. Post.*

*French Steamers.*—The *Railway Moniteur* gives the following list of steamers now building for the French government.

| NAME. | PORT. | ENGINEER. |
|---|---|---|
| Darien | Cherbourgh | 450 H.P. M. Cavé of Paris. |
| Ulloa | Ditto | |
| Christ. Columbus | Brest | |
| Magellan | Ditto | |
| Cacique | L'Orient | Gov. Steam Factory Indret. |
| Eldorado | Ditto | |
| Carib | Ditto | M. Schneider, of Creuzot. |
| Canada | Brest | |
| Labrador | Toulon | |
| Orinoco | Ditto | |
| Albatross | Ditto | |
| Greenland | Rochefort | M. Hallette, of Arras. |
| Montezuma | Ditto | |
| Panama | Ditto | |
| Espador | Indret | 220 H.P. M. Pauwels. |
| Caimar | Ditto | |
| Phoque | Bichwiller | M. Stehelin. |
| Glan | Ditto | |
| Cuvier | L'Orient | Miller, Ravenhill & Co. of London. |



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# Mechanics' Magazine,

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## THE "ERA STEAMER" AND ZANDER'S STEAM EXPANSION AND CONDENSING SYSTEMS.

Fig. 1.

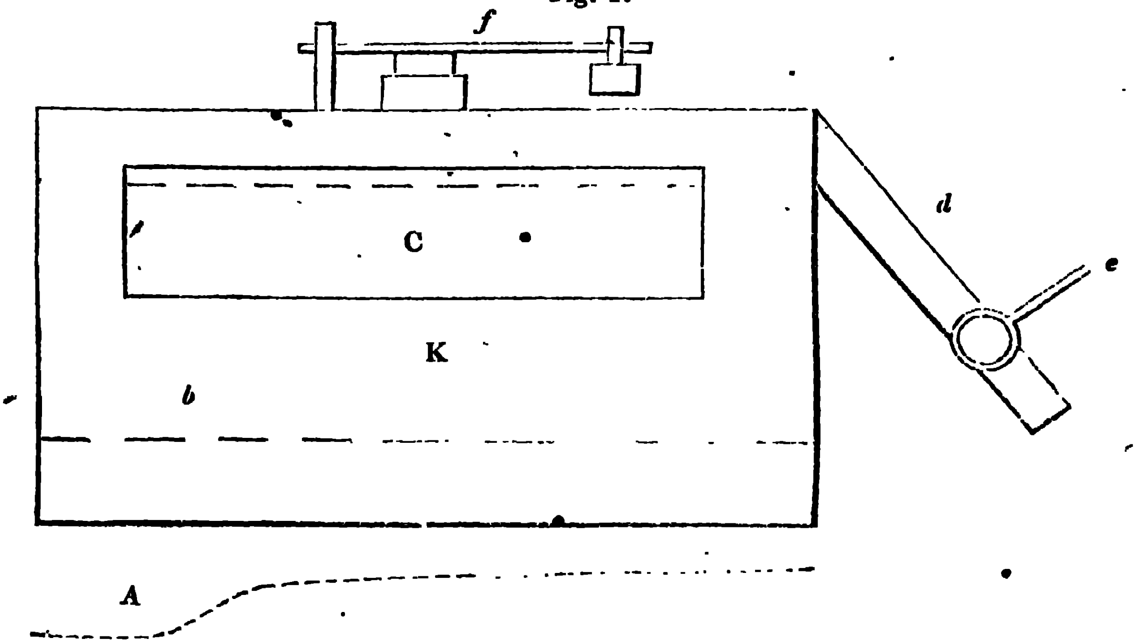



Fig. 2.

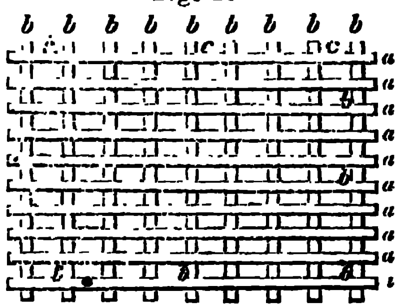



Fig. 3.

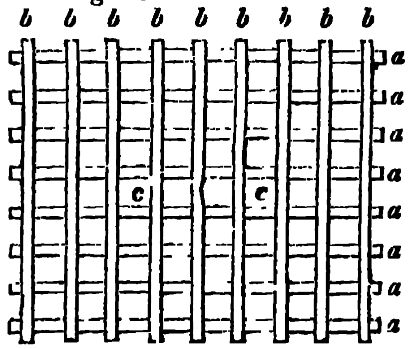



Fig. 4.

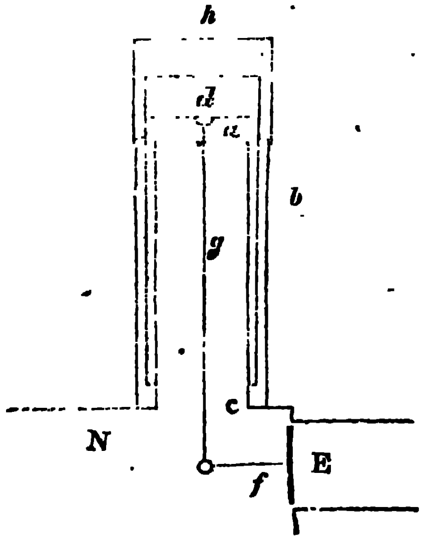
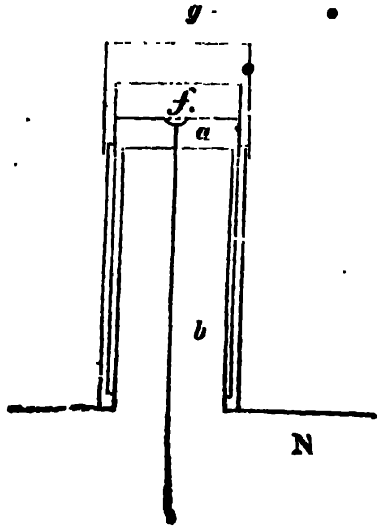



Fig. 5.



## THE "ERA STEAMER" AND ZANDER'S EXPANSION AND CONDENSING SYSTEMS.

The favourite passage boat between London and Richmond during the past season has been the *Era Steamer;* but of those who have travelled by her, perhaps not one in a thousand has cared to inquire how the excellent performances, for which she is remarkable, have been accomplished, or indeed ever imagined that there is anything in or about her different from other steam vessels, beyond, perhaps, a little more skill and attention in management. A visit to the engine room of this vessel will, however, soon satisfy any intelligent inquirer who is moderately conversant with the steam-engine, that there is not only much in the construction of her machinery which is new, but that there are advantages resulting from this novelty, far beyond any which a mere above-deck survey would suggest.

The engine is on Woolf's plan, that is, with two cylinders, one smaller than the other, in the proportion of 3 to 1, and the steam, of course, is worked expansively; but certain additions have been made to Woolf's arrangement, by which the gain from expansion is carried to a much greater extent than it has ever been before. According to Mr. Zander, the inventor of these additions, the *Era* performs by his improved means of expansion three times the duty of an engine worked in the common way without expansion; or, in other words, is worked at a saving to the owner of two-thirds of the ordinary expenditure for fuel; and from the data and calculations which we shall presently lay before our readers, there is every reason to believe, that this is by no means an exaggerated statement of the gain realized. Nor is this all; for though the steam is usually worked at about 40 lbs. pressure, while most of the other vessels which ply above bridge are worked at 7 lbs. and 10 lbs., the same additions to the machinery, by which the great economy in fuel is effected, are of such a nature as to obviate all danger on the score of excess of pressure.

The additions to which we refer form part of a series of improvements for which Mr. Zander took out a patent more than three years ago, (June 17, 1839;) and the real history of the *Era* we understand to be, that, though plying as an ordinary passage-boat between London and Richmond, she was fitted out for the more immediate and express purpose of testing, on a practical scale of sufficient magnitude, the efficiency of Mr. Zander's system of expansion and other improvements before bringing them more prominently under the notice of the public. The *Era* was in constant daily work during the whole of the season of 1841, as well as that which has just terminated; so that the results we have now to speak of are not those of any holiday trial, or a dozen such trials, but the result of more than a *twelvemonth's continual working*, under almost every possible variety of seasons and circumstances.

The description given by Mr. Zander, (who is a native of Sweden,) of his system of expansion, in his Specification, has the defects to be expected at the hands of a person describing, in a language not his own, things which it is least of all easy to describe in any other than one's vernacular tongue; but it is so distinct and clear, nevertheless, that we prefer giving it as we find it, to any version of our own. We have great pleasure in adding, that, should any of our readers desire to refer from our pages to Mr. Zander himself, they will meet with a degree of sincerity, modesty, and singlemindedness, which are not always, or indeed often the accompaniments of inventive genius and scientific acquirements.

"I will suppose," says Mr. Zander, referring to a drawing, of which fig. 1, on our front page is a copy, "that K is a steam boiler of a capacity to contain nine cubic feet of steam put into a boiling state."

"*A* is the furnace; *b* the water line in the boiler; C is an open box filled with five cubic feet water, and fixed to the upper part of the boiler in such a manner that the steam from the boiler surrounds the water on all sides, or the sides of the box. It will be plain that the water in the box C is by the steam in the boiler heated to the same temperature which it itself possesses, after which it goes out in the atmosphere through the pipe *d*. When now the cock *e* is closed, the steam increases in power (or pressure,) but in an inconsiderable degree, because the water

Fig. 6.

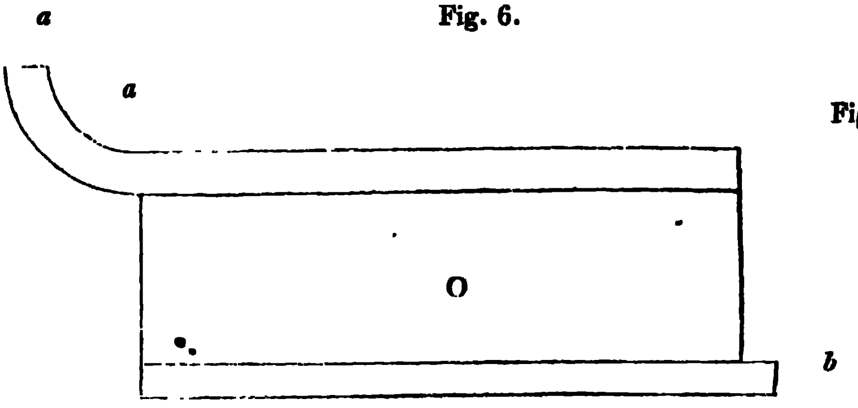



Fig. 7.

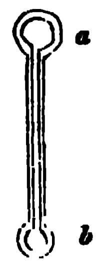



Fig. 8.

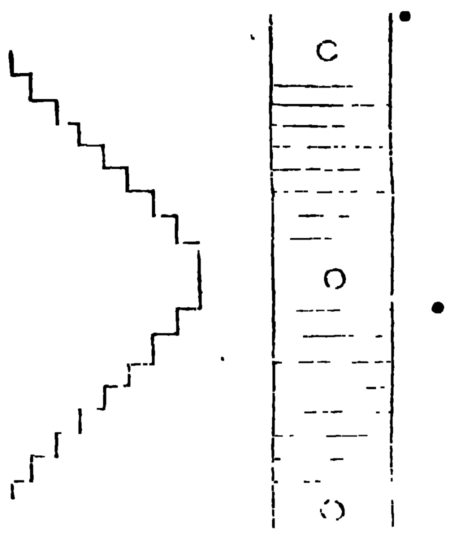



Fig. 9.

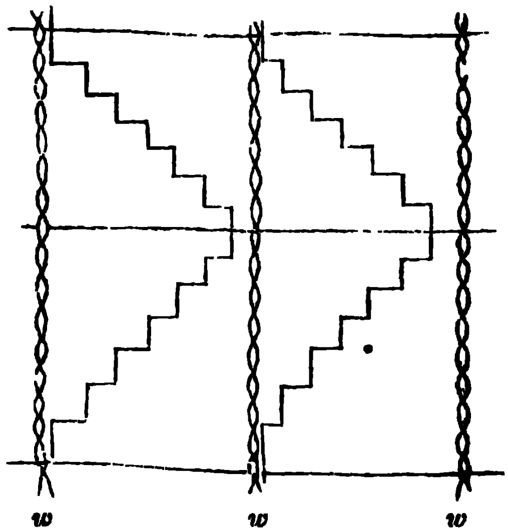
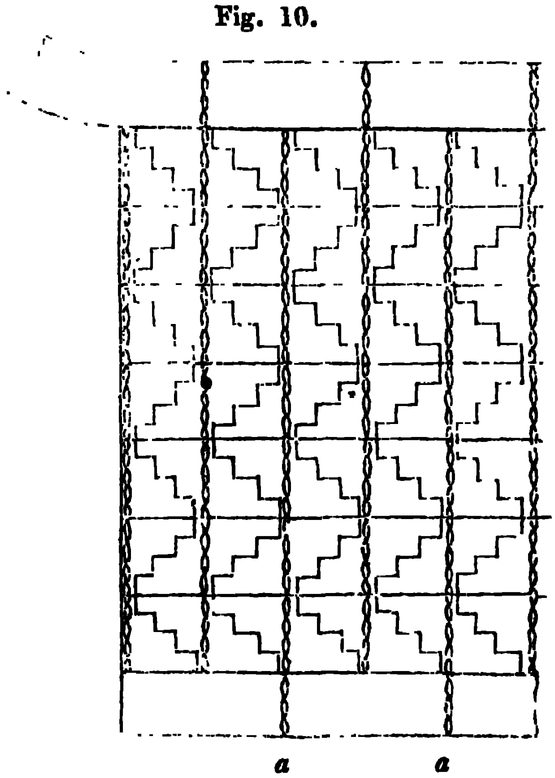



Fig. 10.




which stands in the box C receives the steam and its heat, until the same has acquired the same heat as the surrounding steam, after which the pressure of their steam rises, but

always in equal proportion, with the increase of the temperature of the water in the box C. Suppose now that the safety ventilator, (safety valve ?) *f*, to be loaded, with, for instance, five pounds on every square inch of its sectional area. When the steam in the boiler, and the water in the box C, has arrived at a temperature of two hundred and twenty-six degrees Fahrenheit, the ventilator begins to rise, and the steam to escape. I have found that it required one hundred and fourteen cubic feet of steam from the water in the boiler, to give the water in the box C the same temperature and pressure; but when this box is removed it requires only three cubic feet of steam from the water in the boiler, in order to produce five pounds of overpressure, or two hundred and twenty-six degrees Fahrenheit temperature. I have consequently reservoired 22⅕ times more of steam in the water of the box C; but if the cock *e* is now opened, it is evident that the steam in the boiler K escapes into the atmosphere. The water in the box C has, in the first instance, two hundred and twenty-six degrees temperature, and its steam five pounds of pressure above the atmosphere; it therefore evaporates, and the steam escapes through the pipe *d*, until it has got a temperature of two hundred and twelve degrees Fahrenheit, and equal pressure with the atmosphere, or the steam in the boiler, it must evaporate nearly the one hundred and fourteen cubic feet of steam received. The only inconvenience which now presents itself in carrying this into execution, is, that the heat of the steam requires *a certain time* to pass into the water layer in the box C, and also at a decreased pressure to be enabled to evaporate therefrom, and much heat escapes unused from the sides of the box; but this obstacle is perfectly removed by dividing instead of the single box C, the same into several parts, and by retaining the same water surface in each part. If I then have divided this water, in, for instance, ten parts, it follows that the heat of the steam from the boiler will pass into the mass of water nearly ten times quicker, and at a decreased pressure in the chamber, and will evaporate nearly ten times faster, or approximating thereto. In the construction of the steam reservoir, it is therefore advisable that it should be divided into as many small parts as possible, in order to give as large a surface as may be possible.

"For marine and other steam-engines, I have considered the form of the water chamber to be the most suitable, as is shown in figures 2 and 3, front page:—*a, a,* are narrow guides or channels about a quarter of an inch high, and from a quarter to a half, or greater inch wide, made of copper or other metal. These guides lay transversely below another layer of similarly made metal guides *b*, until a series of guides shall have been formed as high as it is intended to have the reservoir. Should it be required to have a reservoir of a large size, the length of the guides may be divided into several partitions, and in order that the water in them may not during a high swell or sea, go out from one partition to another, partitions made of plates may be placed between them, and a smaller partition may also from the same reason be made in each guide by pressing up its bottom in different places. The guides are attached to each other in one system by brass, or other wire, in any convenient manner; the guide system is then placed in a room or chamber above the boiler, about three inches from the top plate.

The good effects of the preceding arrangement are next detailed.

"The very superior advantage to be gained by the use of this method invented by me, and here above described for reserving the water steam, must therefore be evident, both as regards the lessening the capacity of the boiler and the quantity of water which is thereby gained, as of offering a greater security against explosion when a sudden generation of steam takes place. But the greatest advantage to be derived from the use of this apparatus is, that the steam may be made use of dilated to an extent above what hitherto it has been possible to effect with advantage, because, owing to the difficulty of an over collection of steam in the common steam chamber, there has been a great obstacle in the use of expansive steam-engines, whose preference before others is now fully established. In order to carry into effect the above purpose, I make use of a cylinder, wherein I intend to introduce from a boiler, with steam reservoir apparatus, high-pressure steam, from four, or higher atmospheric pressure. Suppose, for instance, four atmospheres of steam, at one-fourth of the length of the stroke, the steam will be cut off, and afterwards, with its dilation, act to the end of the stroke, where it has one atmosphere of pressure, and now to be conducted into a steam reservoir, in which there is a system of guides which contain heated water, filled in by a cock on the top-plates, on a convenient mode, or pumped from the bottom. The steam is then inclosed in the water of the steam reservoir, and is conveyed thence by means of opening the escape ventilator into another low-pressure cylinder, exactly similar, as to quantity and quality, as if it had been generated in a boiler, with only a loss of about one-fourth of a pound

to one pound of pressure. But I consider it as a great loss not to suffer the same steam to dilate at least four times, also, in the low-pressure cylinder, before it escapes into the condenser, from which I likewise obtain a gain. I can by the method now described, with advantage, suffer the steam to dilate at least sixteen times of its primitive capacities. The steam reservoir, which receives the steam that comes from the high-pressure cylinder, may be placed in any position most suitable; but in steam-vessels it may, in most cases, be convenient to place the same above the boiler, from whence a pipe conveys the steam to the low-pressure cylinder. The before-described steam reservoiring system may be used with advantage in all kinds of boilers or steam chambers, in order to regulate the steam; I therefore reserve to myself the right of making use of the same, in whatever kind of boilers or steam chamber, whether high or low pressure, as thereby I obtain, first, a steadier steam; second, greater security against explosion; third, the practicability of thereby using smaller boilers and a less quantity of water; and fourth, and chiefly, that by use of them one great dilatation of the steam is possible."

In the *Era*, the steam regenerator is not as recommended in the preceding extract, and shown in fig. 1, placed above the boiler, but between the two cylinders of the engine; an arrangement rendered expedient in this case, probably, by the small height of the engine-room.

The boiler is a tubular one, but with a peculiar arrangement of the tubes, for which Mr. Spiller, the maker of both the engine and boiler, had a patent some years ago.

The steam, it must be observed, is not allowed to pass unrestrictedly from the regenerator to the low-pressure cylinder; for provision is made that before the communication is opened between them, the steam in the former, shall have attained a pressure of at least one pound above the atmosphere. Mr. Zander gives two plans for this purpose in his specification, which are represented in figs. 4 and 5 of the engravings on our front page; the one shown in fig. 5, is that adopted on board the *Era*. The following is Mr. Zander's description:—

"Fig. 4 *a* is a cylindrical vessel closed at the top, and the lower end plunged in mercury, contained in a circular groove or cavity formed between two concentric cylinders *b*. These cylinders are supported upon the top plate of the reservoir N, and communicates with them by the opening *c*. The cylinder *a* is loaded by the weight *d*, according to about one pound and a half for each square inch of the top area of the cylinder. E is an admission valve; the stem *f* of this valve is attached to the rod *g*, which is attached to the top of the cylinder *a*. When the steam pressure rises in the reservoir N to one and a half pound above the atmosphere, the cylinder *a* will rise, and open the admission valve E; but when the steam rises higher, the load *d* on the cylinder strikes against the frame *h* attached to the cylinder *b*, and the admission valve E is kept open for induction steam to the low pressure cylinder.

"*c* in fig. 4, is exactly of same construction as fig. 3, but from the cylinder top *a*, fig. 3, is a rod *b* attached, which, by a lateral connecting rod, rests on a valve fixed in the bottom of a cylinder *d* into the reservoir and boiler. This cylinder connects, by a bent pipe, the reservoir with the boiler. The weight *f*, on the top of cylinder *a*, is so regulated, or the diameter of the cylinder *a* compared with the diameter of the valve, that when the steam in the reservoir is under three quarters of a pound (according to pleasure) pressure above the atmosphere, the weight *f* will, by the rods connected with it rest on the valve, and keep that open until the steam from the boiler passes through the valve into the reservoir, keeps the steam there over three quarters of a pound pressure; then the cylinder *a* will rise to the frame *g*, and keep the valve closed. Before the engine is set going, a little cock, on the reservoir N, is opened; then the air in the reservoir escapes through it, and it is held open until the water in the reservoir is heated to a proper degree of the steam from the valve."

We have still some further improvements to notice, which Mr. Zander has made in the condenser, or refrigerator. Fig. 6 is a side elevation, and fig. 7 a front elevation of that in use in the *Era*.

"The refrigerator stands in a vessel filled with water or other cooling medium, and the eduction steam from a working cylin-

der enters into the pipe *a*, and being condensed into water goes out through the pipe *b* to the air pump. The sides of the refrigerators are made of copper, and the ends of brass, the distance between them being about a half an inch, and in order to keep them at this distance and not to be pressed by the air, I apply copper slips half an inch wide, and placed edgeways, and bent between the plates. I carry this into effect in such a manner that the slips of plates are fixed in such a way that their surfaces may detain the ·ondensed water for so long a period as is possible during its descent. This is best effected by the slips being folded in several separate places, as is shown in figure 8. The water that is formed by the eduction steam, can only in a slow degree run down these slips, and form a water surface on both sides of the slips, which is not even, but consist of great numbers of elevations and cavities. But in order still further to detain this water there are fixed between each row of slips twisted brass or copper wires, *w w w*, fig. 9. The condensed water runs from, and to them, and to and from the slips, and is formed into an infinite number of drops, and a constant circulation of the water is occasioned; which circumstance, as well as this great surface, is produced by this operation, and takes from the eduction-steam its heat, and perfectly cools it when the valves are open, and before the piston reaches far on its way; but likewise easily to deliver the heat to exterior plates by communicating while the piston travels the rest of the stroke. This mode of steam-condensing may be considered as a compound of condensing with injection water, and condensing against metal plates surface; because this water column as are performed on plates, division plates, and brass wire, has time to communicate its heat while the piston's whole stroke. Then again, in all other condensing apparatus, the eduction steam the greatest part must have been cooled before the piston performs a very little part of the stroke, when a good vacuum will be obtained. Fig. 10, shows the inner construction of a part of a refrigerator made according to the above described method with holes on the slips, and with folded slips; it is in a vertical section. Slips and wire in fig. 10 are combined in one system, and introduced between plates in the condenser, without that be attached thereon, but for to keep them in proper position they have vertical ends, *a a a*, which are double and twisted, and so long, that they go beyond the slips to the condenser's side, as *a a a* show.

"When it is meant to apply the same to large engines, it is to be made into several single refrigerators, placed close to each other in a water cistern, and provided with induction and eduction pipes in common with them all, and also one pipe furnished with a cock in each end placed between the condenser and the air-pump; which pipe fills with steam from the boiler or reservoir before the engine is set a-going, and is called the blowing through pipes; there it serves, because it gives one partial vacuum when the engine shall go, and induction steam cock is shut, and the other cock to the condenser is opened, then the air before of the steam is forced through the air-pump communicating with the air-pump, and this pipe is therefore always open. Distilling of sea or other water to be replaced, that water lost from leakage, of water or of steam in the engine, can be performed by those engines according to that method which is convenient."

The refrigerator, on the preceding plan adopted in the *Era*, has never, during the last six months which it has been at work, gone once out of order, or required any repair, and is now, we are informed, in as good working condition as at first.

During the long, and it may be fairly admitted, decisive trial which Mr. Zander's improvements have had on board the *Era*, he has taken great pains to contrast the capabilities and performances of that vessel with the latest built and best of those plying above-bridge, and has collected a mass of most valuable data on the subject, from which he has permitted us to select the items contained in the annexed table. The vessels compared, are, it will be observed, all nearly of the same dimensions, and (nominal) horse power; and as they have been all working under precisely the same circumstances as to depth of water, tidal influences, and nature of duty performed, there can hardly be any objection taken to the fairness of the comparison instituted. The superiority of the *Era*, in all that regards economy of working, and in speed also, over at least five of her competitors, is most remarkable.

## COMPARATIVE TABLE OF THE DIMENSIONS AND PERFORMANCES OF SEVEN STEAM BOATS PLYING ABOVE LONDON BRIDGE.

| | Era. | Thunder and Lightning. | Minerva. | Vivid. | Eclipse. | Thistle. | Dart. |
|---|---|---|---|---|---|---|---|
| Length ... | 85 feet | 85 feet | 100 feet | 95 feet | 95 feet | 85 feet | 81 feet |
| Breadth of beam ... | 12 feet | 11 feet | 11 feet | 13 ft. 6 in. | 13 feet | 11 feet | 11 feet |
| Depth of hold in engine-room ... | 5 ft. 11 in. | 6 feet | ... | 7 feet | 7 feet | 7 feet | 7 feet |
| Draught of water midships ... | 2 ft. 5 in. | 2 feet | 2 ft. 3 in. | 2 feet | 2 ft. 3 in. | 2 feet 6 in. | 2 feet |
| Midship sectional area under the water line ... | 24·84 sq. ft. | 17·94 | 20·58 | 22·94 | 25·62 | 24·16 | 18·44 |
| Surface of displacement ... | 1048 sq. ft. | 820 | 1022 | 1·052 | 1·070 | 871 | 769 |
| Area of resistance caused by friction of exterior surface ... | 1·615 sq. ft. | 1·141 | 1·540 | 1·484 | 1·626 | 1·394 | 1·106 |
| Dynamical resisting surface, composed of the midship sectional area and friction of exterior surface of the vessel ... | 26·485 sq. ft | 19·081 | 22·129 | 24·424 | 27·246 | 25·554 | 19·546 |
| Diameter of paddle-wheel ... | 10 ft. 4 in | 10 ft. 4 in. | 11 ft. 6 in. | 12 feet | 11 feet | 12 feet | 11 feet |
| Length of paddle-board ... | 5 feet | 5 feet | 4 feet | 4 feet | 4 ft. 6 in. | 3 ft. 6 in. | 4 ft. 8 in. |
| Breadth of ditto ... | 1 foot | 1 foot | 1 foot | 1 ft. 2 in. | 1 ft. 2 in. | 1 foot 2½ in. | 11 inches |
| Number of boards in each wheel ... | 12 | 12 | 12 | 10 | 12 | 12 | 12 |
| Area of each paddle board ... | 5 sq. feet | 5 | 4 | 5·444 | 5½ | 4½ | 4 5.18 |
| Number of paddle-boards immersed in the water in both wheels ... | 5 | 5 | 5 | 4·286 | 5 | 5 | 5 |
| Area of paddle-boards in both wheels, or total effective paddle surface ... | 25 sq. feet | 25 | 20 | 23·33 | 26·25 | 21·25 | 21·395 |
| Total effective paddle board surface, taken as part of the sectional area of the vessel under the water line ... | 1·606 | 1·393 | 0·971 | 1·017 | 1·024 | 0·879 | 1·159 |
| The same, taken as part of the dynamical resisting surface of the vessel ... | 0·943 | 1·310 | 0·903 | 0·955 | 0·963 | 0·831 | 1·094 |
| Nominal horse-power of the engine ... | 24 | 24 | 24 | 27 | 27 | 27 | 22 |
| Diameter of cylinders ... | 17½-24 in. Zander's eng 2 cylinders | 20 inches 2 cyl. | 11 inches Woolf's eng. 2 cyl. | 22 inches 2 cyl. | 22 inches 2 cyl. | 22 inches 2 cyl. | 20 inches 2 cyl. |
| Length of stroke ... | 20 inches | 2 feet | 2 ft. 6 in. | 2 feet | 2 feet | 2 feet | 2 feet |
| Length of stroke when the steam is cut off ... | 6·6 inches | 12 inches | ... | uncertain | ... | ... | ... |
| Number of strokes per minute ... | 33 | 36 | 34 | 35 | 32 | 32 | 31 |
| Degree of expansion ... | 9 times | twice | 4 | about ⅓ | none | none | none |
| Pressure of steam in the boiler over the atmosphere ... | 40 lb. | 10 lb. | 36 lb | 7 lb. | 7 lb | 7 lb. | 10 lb. |
| Velocity of the vessel in still water ... | 9⅝ miles | 10 | 9⅞ | 9½ | 9 | 9 | 8⅞ |
| Consumption of steam, at 25 lbs. absolute pressure in one minute ... | 132·782 cu.ft. | 314·064 | 228·540 | 650·250 | 594·512 | 594·512 | 511·030 |
| Consumption of fuel (coke, except in the case of the Minerva,) in fourteen hours, including stoppages ... | 952 lbs. | 2119 | 1792 coals | 2912 | 3248 | 3248 | 3584 |
| Work done per cubic foot of steam at 25 lbs. absolute pressure in one minute (dynamical number) ... | 151·551 | 60·755 | 73·569 | 32·200 | 3 ·409 | 51·334 | 25·254 |
| Work done by 1 lb. of coal consumed in the fire-place (dynamical number) ... | 21·137 | 9·031 | 9·382 | 7·191 | 6·115 | 5·735 | 5·812 |
| Cubic feet of steam consumed for one-horse power of the engine at 25 lb. absolute pressure in one minute ... | 5·532 cub. ft. | 13·083 | 9·522 | 24.083 | 22·018 | 22·018 | 24·592 |
| Ditto ditto lb. of coal for ditto in one hour, including stoppages ... | 2·833 lb. | 6·278 | 5·33 | 7·70 | 8·59 | 8·59 | 11·63 |
| Comparative consumption of steam at 25 lb. absolute pressure in any given time for work done, the Era's consumption and performance being taken as the standard unit ... | 1 | 2·494 | 2·059 | 4·765 | 4·536 | 4·836 | 6 |
| Ditto of coal for work done ... | 1 | 2·347 | 2·252 | 2·939 | 3·456 | 3·685 | 5·544 |

Sir,—Whilst investigating the phenomena connected with the winds, the tides, and the currents of the ocean, previous to a publication on the subject which I have in progress, I am led to remark, that though the times of high water seem very generally to have been noticed in foreign parts, as well as the local currents, yet, as far as some of the descriptive memoirs are concerned, little can be said in favour of their consistency; neither are we more enlightened, (notwithstanding the vaunted travels of scientific men,) as to the sources whence these tidal waters emanate, where they meet, how the local currents affect the periods of high water in their several vicinities, or in what manner they expend themselves; whilst the hypothesis of Bernardin St. Pierre has, in these respects, been treated with unmerited derision.

We are, however, informed by those who are in the habit of visiting tropical climates, and who consider themselves fully conversant with the vicissitudes of West Indian and North American navigation, that the tide of flood along the shores of the United States, as far northward as Nantucket, and consequently, through the Bahama Islands, is propagated from south to north; or, in other words, that it is derived exclusively from the southern hemisphere—a notion in itself as contrary to principle as it is irreconcilable with observation, whether the frontier tides, or those of the interior be alluded to. As well indeed might it be said, that the original supply of water is propagated from north-west to south-east, or S.S.E., on the coast of Guiana, because it is high water at Port Spain, Trinidad, before it is so at Salinas, a retrogression solely produced by the velocity of the Equatorial current, when passing Point Galera, and the effects of the deep inlets at Para and Maranham. For as the times of high water at Cape Sable, Sandy-hook, Gay-head, Cape Henry, Charleston-bar, and St. Augustine in America, and at the Isle of New Providence, accord on an average within 50 minutes of each other, the system of progression there, is at once destroyed. It is, moreover, utterly impossible that the same wave which travels from the Equator, and makes high water at Arguin-bay, in Africa, Guadaloupe in the West Indies, and Rio de la Hacha on the Columbian shore, should extend its flexure from thence all across the Northern Atlantic, and produce a simultaneous elevation of the water upon the American coast, over a space, too, very little short of 1400 marine miles. It is equally improbable that the water should occupy as much as 12 hours in crossing this part of the Atlantic from east to west, when it travels from the Cape of Good Hope to Cape Clear in 15 hours, which is three times the distance. That the tide of floods along the coasts of Africa, on the one hand, and along those of Guiana and Columbia on the other, as well as through the West India Islands, as far as Guadaloupe, really does come from the Southern Ocean, is quite clear, but it is no less certain, that the rising water on the coast of Nova Scotia, and along the shores of the United States, as well as throughout the Bahamas, is furnished from the Greenland seas, whence, taking its course to the southwestward, (after rounding the protuberance at Cape Race because invited so to do by the peculiar trend of the American coast line, and the angle that coast line makes with the course of the earth's rotation) indirectly visits Bermuda in its progress to the southward, whilst on the coast of Africa, the tide, after rounding Cape Verde, is equally propitiated by a corresponding recession in the opposite direction to the northward of Cape Blanco, and in like manner (though directly) visits the Azores in its progress to the northward. This natural propensity of the flood tide, along the American coast, may be actually traced to St. Augustine in Florida, and though it becomes temporarily merged in the superior draught of the Gulf stream during its farther progress, again appears running to the southward between the Little Isaac and the Berry Islands, and to the east and south-east at the Lobos and Guinchos Cays in the Old Bahama Channel, and even at Porto Rico, whilst another portion, winding round the west end of Cuba, finds its way into the Bay of Honduras, and thence round Cape Gracias a Dios to St. Juan de Nicaragua, manifesting, as might be expected, a point of convergence, (with respect to the tides of the two hemispheres,) somewhere between the latter port and Port Escoces,

and a point of divergence, on the north coast of Cuba, between the Havanna and Cayo Frances.

It must, moreover, be evident, that the waters in the Bay of Fundy owe their occasional extraordinary elevation, not to the miraculous intervention of a tidal wave from the distant coast of Africa, as hitherto supposed, but rather to peculiarity of position, and sinuosity of shape, combined with the effects of the autumnal rains, and the summer fusions of the ice and snow collected in those regions during the winter, and the influence of the Florida stream, which, necessarily preserving a great proportion of the impetus it derives from the alignment of the coast between Cumberland Island and Cape Hattera, (a direction of N. 48° E.) operates with considerably less comparative energy upon the Chesapeak, the Delaware and the Hudson, than when it again encounters the shoals of Nantucket and George's Bank, where, meeting with direct resistance, it inclines more easterly, and crossing the mouth of the Bay of Fundy, necessarily promotes the accumulation of the waters whilst rising, and proportionably impedes their escape when falling. The times of high water along this coast, even in the interior, differ but little; it is high water in Hampton Roads (Virginia) in the harbour of St. Augustine (Florida), and at Cape Chignecto nearly at the same time; but between Chester and Newcastle in the Delaware, where the southern tide, if it existed, would necessarily show itself previous to reaching the Bay of Fundy, it is not high water till V. 16.

From these considerations it will become manifest, that there must be a certain space in the open sea, between the two continents, where the accessions from both hemispheres eventually coalesce, and where also, in association with the oceanic current, as they recede from the land, they will generate an eddy, or more correctly speaking, a circumgyrating motion in the water, of very considerable extent, the position of which, under ordinary circumstances, may be pretty nearly defined, by drawing an anfractuous line from the Archipelago of Chiriqui, to the Feroe Islands, through the island of St. Eustatius, the two cusps of the Sargasso Sea, the island of Corvo and Rockall-rock—a coalition more particularly exemplified between the parallels of 22° and 36° N., and the meridians of 34° and 39° W., for the almost constant presence of the *fucus natans* within those limits, and its crescent-like shape can only be ascribed to the effects of circumgyrating motion above alluded to, whatever others may surmise to the contrary, upon or near which line the meeting of the Atlantic tides must certainly take place. This line, with reference to the earth's motion, may be still farther extended, and thrown to the north-westward, between Spitzbergen and Gall Hawke's Bay. On the coast of Africa, however, the Florida stream not only loses much of its force, as well as its heat, from the diffusion and incorporation it is necessarily subject to, during its passage across the Atlantic, but approaches that coast between Cape Cantin and Cape das Barbas nearly at right angles; the tide there, in consequence, overcomes the effect of the current so far as to exhibit more consistency in its progress to the northward, than that on the opposite shore of the United States does to the southward. The great increase of cold alluded to in Purdy's memoir of 1840, page 479, would indeed be very extraordinary, if naturally indicated by the mercury, as we know that salt water freezes at the temperature of 28°; but it must be also recollected, that the same dependence cannot be placed on the expansion and contraction of the glass-tube of a thermometer, and the corresponding range of the mercury within it, when, beyond the extremes of 212° and 32°, as when between them. On the other hand, the increased heat alluded to in the same memoir (p. 480) found beneath the water in the vicinity of Spitzbergen, may be reasonably accounted for by the course of, and emanations from, the Florida stream, aided by the volcanic construction of Iceland, and Jan Mayen's Island, where the geysers are known on some occasions to equal in heat the boiling point of Farenheit.

Lastly, the five instances recorded in Norie to prove that the current in the Straits of Gibraltar (the centre) has been found on some occasions to run to the westward, are not only altogether vague, but when properly examined, will show, that they bear no more upon the phenomenon in question, than they do upon the current in the Straits of Magellan, an assertion I shall hereafter more particularly exemplify.

STATUARY HOW FAR IRON IS A SUITABLE MATERIAL. BY BENJ. CHEVERTON, ESQ.

Sir,—The proposal to cast statues in iron, attributed to me by your correspondent, Mr. Partridge, was, I believe, suggested or advocated rather by Sir John Robison, and is one which I should hesitate to recommend. I speak generally, for there is one case to which I shall presently advert, in which undoubtedly iron would be the best material.

In matters relating to art and taste, circumstances will ever predominate over principles in guiding the judgment to a correct conclusion. Every case will have its own adjuncts and conditions, and to a fine natural or skilled perception of the fitness and propriety of things, must be left the task of adjusting, proportioning, and harmonizing them with artistic effect. No one material is best or good for the purposes of statuary under all circumstances, be it ivory, marble, alabaster, bronze, or iron; and this proposition is true if taken in reference merely to art, and independent of durability, or of economical considerations. The nature of the material in regard to its opacity, or its degree of transparency; the character of its reflected and its transmitted light; the depth and quality of the shadow that it casts; the nature of the material in regard to its surface, its power of scattering and of absorbing light, its mechanical texture and its colour, both in themselves and as bearing on the above several points; are all circumstances of suitability which must be consulted in connexion with other circumstances of light, size, and locality, before any opinion can be safely advanced as to the preference of one material to another in any given case. I believe I state the opinion of artists in general, that of all the materials I have mentioned (except, perhaps, alabaster in quite the opposite direction) iron is in point of taste the most unfit for statuary works of art.

Economy, it is true, is a powerful consideration, and is too apt in the present day, even in departments of art, to overrule all other considerations, but it is not so much in favour of iron for statue as may be imagined. The cost of these expensive productions of art lies not in the material so far as bronze is concerned, which amounts not to more than from the fifteenth to the twentieth part, but in the reward which genius of the highest order, or at least of the first existing rank, will always command,—in the *artistic* talent required in aid of the subordinate modelling,—and in the great quantity of *skilled* labour employed in the manipulation of every part of the work. In the last particular, the use of iron would entail great additional expense, from the difficulty of bringing the castings to anything like a tolerable surface, and from the greater magnitude of the operations—it being impracticable *to burn*, that is, to fuse the castings of the several parts to each other as is done in bronze.

If it be proposed to coat the iron with copper by the electro-metallurgic process, I am quite confident, from the considerations just named, and from the additional manipulations required, that the expense would be greater than by the present mode of casting in bronze. The statue also would require to be large, and the coating thin, in order to avoid perceptible distortion. The better way in every respect would be to employ electro-metallurgy in the entire formation of the statue, first depositing in the interior of a mould a sufficient thickness of copper, and then strengthening it by a deposit of a cheaper metal, as zink. Or, an alloy may in the first instance be deposited of copper and zink, in accordance with Barret's patent process, reducing the proportions rapidly, so that zink may form the great mass of the metal. Even on this plan, I am very doubtful whether the expense would, by any process yet made public, be less in respect to all models of the colossal or the heroic size, requiring but one copy, than that of ordinary casting. Individual and isolated enterprises in this matter among sculptors would be ruinous failures. The object could only be accomplished with a profit, by an establishment with the *plant* and means devoted to such purposes generally, to whom artists could entrust their models with a certainty of having them back uninjured, and of having also a successful copy. Even such an establishment, and I speak from knowledge, would have to feel their way cautiously, and through gradual operations from the smaller to the larger.

There is a point, I am convinced, though I do not know where it exists,

beyond which the electro-metallurgic process would not be advantageous. As we proceed in size, the parts are large in themselves, and are moreover modelled in a massive style, to comport with that size, whereby the roughness of the surface, and the inexactitude of minor details, become matters of so little moment, that the ruder process of casting is amply sufficient. Indeed the literal transcript of every minutia of the surface which the electrotype gives, is a disadvantage even in the smallest works of art, unless the model be susceptible of, and has received, the highest finish. But in a large statue, the eye removed to the proper distance, regards only the general form.

I have heard it remarked that the marble statues of Sir Francis Chantrey never produced a finer effect than when seen by twilight in the workshop in a *half-finished* state; that is, just from the hands of the *pointer*. This is a severe but a true test of intrinsic worth, the judgment being unbiassed by meretricious or even adventitious excellence of mere execution, either to enhance the merits of the work, or to extenuate its faults. Now colossal statues are seen not only in an analogous point of view, but under conditions yet more restrictive and exacting. I allude to those of the first magnitude, and whose situation is of course in the open air; for those of a secondary size, if placed in buildings, and particularly if the material is marble, are not subjected to circumstances so inimical to effect. But the large colossals are placed generally on high—they are seen with advantage only at a distance—and the calculated intention of the style in which they are modelled is, that they should be both seen and appreciated only at a considerable distance. For this purpose, all the parts, and even the features, are massive and few in number. The modelling is in a style of grandeur to correspond with the grandeur of magnitude. The minuter details of likeness are omitted; those that remain are not delineated in literal conformity to the life-size bust of the individual, but are exaggerated to such a degree, that if the artist took the direction of the ludicrous instead of the grand, it would amount to a caricature. So situated, they are exposed to a diffused light unfavourable to shade, and to the discrimination of parts; and this evil is greatly aggravated by the dingy hue which, in our climate, at least, they very quickly assume, to the effect of swallowing up shadow in colour. If, in such circumstances, the form, as defined by the general contour, is inelegant or unbalanced, no superficial arrangement or division of parts, however bold in character, will suffice to redeem it; no cutting, however deep, which does not go to the extent of letting the light through, will obviate the bad effect it will have in the distance, although, perhaps, to the beholder, when in the artist's studio, the deep shades thus produced may be thought amply sufficient to afford the relief intended. In these colossals it is the outlines that tell effectively, and also the shadow which projection throws, far more than the shade which incutting affords.*

These observations lead me to the only case in which I can admit that iron would be a proper material for statues; for where artistic skill finds so little room for display—where it is confined to the highest quality of the art, and within limits of such severe simplicity—where the advenient means usually found so effective to pourtray composition and design, are rendered nugatory by being almost or altogether lost to view, it cannot, in an artistic point of view, be a matter of the slightest importance what the nature of the material is, what the character of its surface, or what indeed its colour, unless the statue can be prevented from becoming black. The microscopic accuracy of delineation afforded by the electrotype process will cease to have any utility long before it arrives at this extreme point, but here it is manifestly useless; even the coarseness of iron castings, the impossibility of fusing them together, the rude and joint-showing method of uniting them by inside flanges, and the inaccuracy of their fittings, are all matters of the utmost insignificance; and therefore iron, as being

* The finest statue in the metropolis for colossal qualities, though hardly itself to be called colossal, is, in my judgment, that of Pitt, by Chantrey, in Hanover-square. Its symmetry and balance, from whatever side, or at whatever distance, it may be viewed, is—if I may be allowed something like an Hibernianism—perfect to a fault. Its outline in any direction is elegant, and pregnant with meaning and indication of what perhaps the spectator is too distant distinctly to perceive through the medium of light and shade. Its style, also, is eminently grand and dignified.

cheapest and strongest, and the least liable to excite the cupidity, or yield to the fanaticism, of future generations, is undoubtedly in this case the best material that could be employed. Next to this, in the descending order of size, and wholly grounded on considerations of taste, I would rank granite and marble, reserving ivory and bronze for the miniature productions of art; but as our climate is unfavourable to durability in exposed situations, matters of taste must occasionally be overruled by considerations of expediency, and therefore bronze is the best material for statues of a moderate size in the open air. The durability of cast iron is a subject on which I cannot here enter; but if properly protected from special chemical and galvanic influences, in respect both to the constitution of the metal, and to circumstances connected with the construction of a statue, it would surely last long enough to satisfy the most ardent cravings after monumental immortality; as long, at least, as the time when, to use the words of a *prophet*, "a solitary traveller from Australia shall be found sketching the ruins of the last arch of London bridge."

I cannot conclude without adverting with feelings of deep regret to the timidity which is exhibited by patrons of art, and other influential men of taste, in refraining to countenance any monumental design which departs in the least from what precedent has sanctioned, or goes farther, at most, than ringing changes on what it has dictated. Certainly, they are safe within the circle of plain stone columns, and respectable marble, bronze, or stone statues, from any very stinging condemnatory criticism; but if we are always to go on thus, we shall never ourselves be cited as precedents. Let us at least try what we can do in *colossal granite statues*, and having put forth our might to the extent of rivalry, at any rate, with the Egyptian, we may next take courage to go beyond him, and, with that spirit of enterprise and originality which has so honourably marked our onward career in all matters appertaining to public convenience and utility, break away from the leading-strings by which art is trammelled, through a slavish deference to authority. Our Gothic forefathers, self-emancipated from Greek and Roman bondage, created, as well for posterity as for themselves, an entire new style in architectural art; and that, too, at a time when scholastic prejudices in favour of the ancients were at the highest. If it be not Classic, let it then be British usage, to erect statues in cast iron, but of a size and character so colossal, that, far from militating against the principles of taste, the grandeur of magnitude, and simplicity of design, shall harmonize with the grandeur of strength in the material, and fitly call for the sombre appearance which it presents. What more noble object could have been offered to view in Trafalgar-square—what more characteristic of Britain and the British in a variety of aspects—than a cast iron statue of Nelson, 80 or 100 feet in height? The suitability of the site might indeed, with some reason have been questioned, inasmuch as the space is too confined to have viewed it properly, and is moreover out of character with that, or anything else that is simply grand. It would have frowned into insignificance the petty prettinesses around. Still, another site more appropriate might have been found, or at least a bronze or a granite statue of some 40 or 50 feet could have been erected, which would have been both a variety in that locality, and a novelty in modern times.*

## IMPROVEMENT IN FIRE ENGINES.

Sir,—In working fire-engines, under certain circumstances, a very striking and somewhat inconvenient illustration is afforded of the *vis inertia* of fluids.

This happens when the hose is led to the top of a high building, or has by other means a great altitude given to it. So long as the engine is worked and the ascending column of water kept in motion, the jet is delivered from the branch-pipe in the usual way; but, should the engine be stopped for a few minutes to shift the hose, &c., the pressure of the quiescent column of water cannot be overcome. On beginning again to work the engine, the delivery valves become set in an open position; the engine handles fly freely up and down as the water passes from one

* The largest colossal statue in metal now existing is, I believe, that of Borromeo, on the borders of Lake Maggiore; and, if I recollect aright, it is constructed of copper sheets hammered into form.

working barrel to the other, which is the only effect that can be produced. The *vis inertia* of the high column of water contained in the elevated hose cannot be thus overcome, but must be got rid of in another way. This is done by taking off the screw cap of the delivery orifice opposite that to which the hose is attached—or if there be but one delivery orifice by unscrewing the hose itself—when the water immediately escapes. The cap is then replaced, and the engine set to work *de novo*, when the water rises in the hose and is discharged in a jet as before.

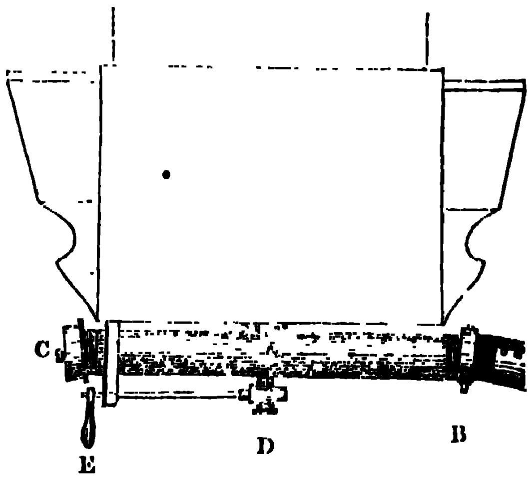
This phenomenon is peculiar to fire-engines with spherical air-vessels and separate valve chambers on Hadley and Simkin's patent principle, in which the valves are hung in an angular position. Different engines, even by the same maker, are more or less liable to this effect, some failing under a shorter column than others. This is especially the case in some country-made engines, in which the valves are so badly adjusted, that in some positions the engine will not work at all. Newsham's engines, with upright or hollow-shaped air-vessels and horizontal valves, are not liable to fail in this manner.

At Streatham church, when struck with lightning, and at several other recent fires, considerable inconvenience has been experienced from the cause stated; and it has been customary to station a man at the engine to unscrew the cap and relieve the hose every time the engine ceased working, by which means much of the evil is obviated.

Removing the cap, however, under such circumstances, is a very unpleasant operation, and is not altogether free from danger; exposed as it is to a pressure from within, of from forty to fifty pounds upon the inch. Besides which, the strain upon the last thread of the screw, just as the cap flies off, is very severe, and very likely to prove injurious.

It is by no means necessary to incur these disadvantages, because it appears to me, that a very simple remedy may be provided; and in order to relieve the hose without removing the cap, I have proposed that a small cock, or valve, should be placed in the cross-arm or delivery main, immediately beneath the air-vessel, as shown in the accompanying figure.

A is the cross arm; B the delivery screw with the hose attached; C, the opposite orifice closed by a cap; D is a




small cock, having about an inch waterway, opened or shut by the handle E. This handle is weighted, so as to have a constant tendency to keep the cock shut.

The advantages of this trifling addition to fire-engines would be very great. In the first place it would afford a convenient and effectual remedy for the evils of *vis inertia*, with much greater rapidity than removing and replacing either the hose or the cap. For, it is not necessary to discharge the whole of the water from the hose; a small portion will frequently suffice to bring the column within the power of the engine, which could be discharged in a second or two. In fact, it could always be accomplished between receiving the words of command "stop her" and "go on," however rapidly they might succeed each other.

In the second place, this cock would at all times enable the hose to be emptied instantaneously, preparatory to lowering it—to shifting its position, or to "making up."

I remain, Sir, yours respectfully,
WM. BADDELEY.

29, Alfred-street, Islington.
September 23, 1842.

## LIFE ASSURANCE.

Sir,—Kinclaven was right in supposing that the question I proposed on Life Assurances, (No. 989,) was not fortuitous. In truth it was sent me for a solution somewhat more than a year ago, and it was enunciated exactly in the same way as I sent it to the *Mechanics' Magazine*. I solved the question, and obtained the same results as those found

by your correspondents Mr. Scott and G. of Pentonville,* (so far as G has gone.) The condition in the question, of one-third of the profits arising from deaths going to the proprietary, appears to have been a stumbling block to G, and this most essential part of the question he does not answer; perhaps G may be connected with some of the Assurance Offices, and therefore did not choose to expose the secrets of the profession.

On Mr. Scott's solution I beg to offer a few remarks. He (Mr. S.) calculates from the data of the Northampton Table of Mortality, interest 3 per cent., that the single premium is 38·386*l.*, or 38*l.* 7*s.* 5½*d.*; and that the amount of this sum for 20 years, together with the profits arising from the deaths, will just enable the Company to pay each surviving subscriber, at the termination of this period, 100*l.* But when one-third of the whole profits arising from such a source goes to the proprietary (for the expense of management, &c.,) the like premium from the same data, he (Mr. S.) calculates to be 44·045*l.* This will produce a present profit to the proprietary of (44·045—38·386) 5·659*l.* for each subscriber, or 565*l.* 9*s.*, for the 100 individuals, and at the end of 20 years, at 3 per cent., this sum would amount to 1,022*l.*; which sum, if we could rely on the accuracy of the data, would be the profit that would go to the proprietary for their trouble of management, &c. But what a sad contradiction, the Swiss Table of Mortality gives to this imaginary gain, obtained from the Northampton data! Mr. Scott has calculated from the Swiss Table, interest at 3 per cent., that the single premium is 45·257*l.*; no part of the profits going to the proprietary. Hence, if the Swiss Table of Mortality tells the truth, the imaginary profit of 1,022*l.*, produced from the Northampton Table, is converted into a positive loss of 218*l.* 4*s.* 3¾*d.*, besides the proprietary having nothing for their trouble. If the proprietary were to allow 4 per cent. their loss would be still much greater.

The Swiss Table of Mortality very nearly agrees with the Carlisle, and the Carlisle Table, with a slight modification, is used in the Equitable Assurance Office, and I believe in many other offices, so that it may be safely asserted that none of these tables give the waste of Life *less* than experience has warranted, besides, no person of common sense with an unsound constitution would ever think of being a subscriber to such a scheme, so that the annuitants might be considered the best lives from the common mass, and the waste of life among them would be less than any Tables of Mortality exhibits. (See *Note* in Price, by Morgan, vol. ii., p. 455.)

I am, Sir, yours, &c.,

IVER M'IVER.

* When I sent my last article I had not read over G.'s strictures on the enunciation, &c.

## MR. BIRAM'S IMPROVEMENTS IN PADDLE-WHEELS AND OTHER ROTARY MACHINES.

Sir,—I feel exceedingly obliged to you for the favourable notice you have taken of my improvements in rotary engines, in a recent Number of your valuable Magazine;* and I should be glad to make public, through the same medium, what I conceive to be the advantages of my side paddles over the common paddle-wheel, as your notice extends merely to their construction.

From the oblique manner in which the vanes or floats enter and emerge from the water, they not only present less resistance to the water at those points, but they may be immersed double the depth of the ordinary paddle,† and therefore the same area of float may be made to act against the water with only half the breadth of wheel; the side plates counteracting the less efficiency of the floats from their obliquity, which would otherwise exist at the required point of action. The number of floats may also be reduced to one-half of those in the ordinary

* There are a few misprints or mistakes, but so obviously such, that I scarcely know whether it is necessary to notice them.

Page 322, 1st col., 12th line from the bottom, the letters C B should be A B.

Page 322, 2nd line 2nd col., for "C B, fig. 1," read "A B, fig. 4."

Page 322, 31st line 2nd col, for "fig. 2" read "fig. 5."

Page 323. In the diagram, fig. 6, the letters E and F should change places.

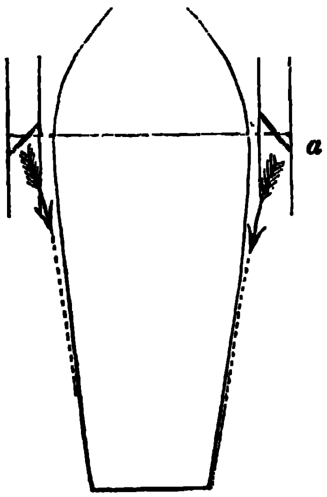
Page 326, 2nd col., 3rd line from the bottom, for "A B" read "C D."

I would also observe, that the remarks made respecting the tremulous motion of steam-vessels being obviated by the *stern* propellers, apply more properly to the *side* paddles; for the stern propellers, being constantly in the water, cause no tremulous motion whatever.

† I consider that the depth the paddle should be in the water, at the load water line, should be half the radius of the wheel.

wheel, as I have found six floats quite as efficient as any greater number.

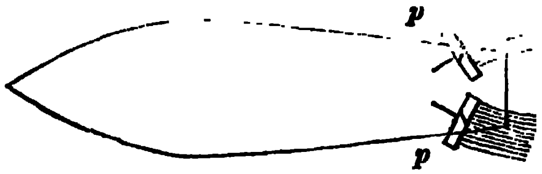
I am also of opinion that a propelling influence is exerted upon the vessel, from the acting floats forcing the water against the inclined plane which the after end of the vessel presents to the line of motion. The two oblique lines, *a a*, represent the position of the two floats in full action, and the arrows the direction of the current in the water, created by the revolution of the wheels. The increased depth

a  a

of the paddles, and reduced breadth, (being thereby nearer the centre of motion,) offer a considerable advantage at sea, upon the heeling of the vessel, the paddles being so much less likely to work out of the water.

I would make a few remarks respecting *stern* propellers. In the course of my experiments I have observed, that the action with only one propeller, placed in the centre of the stern, produced a tendency in the vessel to a circuitous path, caused, as I suppose, by the greater resistance which the under side of the propeller has to encounter from the extra pressure arising from the greater depth of water. This would not be the case, possibly, to the same extent with vessels whose length is so much greater in proportion to their breadth, as steamers generally are, compared with the boat with which I experimented; but still, trifling as it might be, it would be effectually remedied by employing two propellers, with the leaves inclined, and the wheels turning reversewise to each other. This unequal resistance to the propeller, from its varied depth in the water, also leads me to believe that increased efficiency would result by placing the propellers so, that their plane of motion should be at an angle of from 60° to 70° with the vessel's path; in which case, the action of those vanes or floats immersed the deepest in the water, (and which, when one propeller only is employed, creates a rotary tendency in the vessel,) would act upon the water more to the rear, and by so much increase the speed of the vessel. This position, by throwing the axles of the propellers nearer together, would also be more favourable for the application of the power.

In the following diagram, *p* represents the position of the propellers, and the angles they make with the vessel's path.




I have just received the last Monthly Part of the *Mechanics' Magazine*, and the description of the *Great Britain* steamer, with the mode of propelling her. I feel quite confident that, with one revolution of a propeller upon my plan, having the extremity of the floats at an angle of from 56° to 60° with the plane of motion, the vessel would advance as far, as with five revolutions of the propeller there described; thereby rendering unnecessary the large driving-wheel and its attendant straps, the wear and tear of which must be very considerable. Nothing could be more easy than to test the correctness of my assertion, that is, by having a model of each propeller, and causing them to revolve in a vessel of water in which were sprinkled a little bran, small pieces of paper, or other floating particles, when the comparative velocity of the current which each would create, would convince any one how very unnecessary are driving-wheels and straps to stern propellers properly constructed, and that the power might be applied direct from the engines to cranks upon the propeller shaft; the number of strokes per minute of the engine giving quite a sufficient number of revolutions to the propeller.

I have just had constructed two wheels of sheet zink, for the purpose of testing the principle I have laid down as to the relative speed of wheels with vanes at different angles, propelled by fluid, and their power of measuring the velocity of such fluid, or of bodies to which they may be attached passing through any

stagnant fluid, and I am happy to say that the principle is fully verified. The wheels are each the $\frac{1}{80}$th part of a mile in circumference, and in depth equal to $\frac{1}{8}$th the diameter. One has nine vanes, the extremities of which are at an angle of 26° 34′ with the plane of motion, causing it to make two revolutions in the distance of its own circumference; the other has 18 vanes, at an angle of 45°, making, therefore, one revolution in the same distance; so that in passing through the water in the direction of their axes, the first would make 2,000, and the latter 1,000 revolutions in a mile. Indices are attached to each, so arranged that each should make one revolution round a dial-plate in a mile, the plate being divided into furlongs and chains. The wheels were placed in the water on each side of a boat, which was rowed across a pool of considerable size, when the distance passed over, recorded by each index, was found to be uniformly the same; and the total distance indicated, of 13 chains between two observed projections upon the banks, was found also to correspond with the real distance between the two points, when afterwards measured upon a plan. I may observe, that the wheel need not necessarily be any integral part of a mile in circumference; but the angle at which the extremity of the vane should be set, may be found, by dividing the distance which it is intended one revolution of the wheel should pass over, by the girth of the wheel, and the quotient will be the tangent of that angle.

I am, Sir,

Very respectfully yours,

BENJAMIN BIRAM.

Wentworth, October 8, 1842.

## BLASTING BY GALVANISM.

Sir,—In No. 998, page 297, I find a letter signed "J. F. B." I quite agree with your correspondent, that "in doubtful matters, theories, and opinions, may be very erroneous; but that facts in such cases *must* be of value." No one can doubt the correctness of this aphorism, and it would be well if writers like "J. F. B." would attend more to facts, and indulge in theoretical opinions less freely. Your last volume is now at my bookbinder's, but, if I remember rightly, there is a letter in it with the same signature "J. F. B.," in which the merits of Mr. M. Roberts' process of blasting is criticised, and much said in favour of Bickford's patent fuse; indeed so much said, that I was almost led to suppose that the writer must have some interested motive in attempting to cry up the fuse, in preference to Mr. Roberts' galvanic process.

I will, in the first place, advert to the sand tamping. I am myself a practical man, and have been engaged in quarrying operations all my life; during which time, it has been my constant aim, by every means in my power, to preserve the men employed under me from accident by blasting. Tamping by sand has been known in Wales for half a century, or more; but Mr. Roberts' proposal to leave a space between the sand and the powder has not, I believe, ever been tried, until I adopted it in blasting by his galvanic process, so ably described in his pamphlet. In my practice I have never placed over any quantity of powder more than 18 to 22 inches of sand, and in no instance, whether it was placed vertically or horizontally, have I seen the sand in the slightest degree disturbed. In many instances, however, the whole of the rock operated upon has been blown away; and as to such instances, I can of course say nothing.

The first trial I made of the galvanic apparatus was in a slate quarry. The immediate object of the blast was to remove a large body of flint which lay on the slate vein. In the flint there were prepared six holes of two inches diameter, and varying from three to four feet in depth. The whole quantity of powder employed was 18 lbs. The charge was fired, and in no instance was there a failure. The action of all the six charges was simultaneous, and the effect from this cause was such as I had never before witnessed, from ten times the quantity of powder fired at different intervals in the common way; that is to say, by Bickford's fuse. I may mention here that whatever care is taken with the fuse, you can never arrange it so accurately as to insure the simultaneous action of the different charges; I may also state that though the fuse is offered to the men free of charge, they unanimously prefer the old plan of firing the holes with straw, and using ground stone for tamping.

"J. F. B." states, that by increasing the

quantity of powder great effects may be produced without any tamping. Of this our quarrymen are well aware, as they frequently pour large quantities into fissures in the rock caused by the blasting. I have known a barrel of gunpowder throw down above 5000 tons in this way.

Again "J. F. B." says, "of the superiority of igniting charges by galvanism, as an ordinary mode, I am far from being convinced." The language he uses here admits of great latitude. Does "J. F. B." mean large works or blasting a few stones for clearing a field? In extensive works fixed batteries at intervals would, I imagine, be serviceable with main wires for the men to attach branches to. I am about putting them up on this plan, and I feel very confident as to the result.

I need scarcely add, Mr. Editor, that I am altogether unused to writing, and only address you with a view of offering a practical testimony as to the invaluable plan of Mr. Martyn Roberts, who would greatly add to the obligations he has conferred on the mining interest, if he would favour the readers of the Mechanic's Magazine with a description and drawing of the iron battery.

I am, Sir, yours respectfully,

W. C.

Box P. 5, Post-office, Liverpool.

Liverpool, Oct. 11th, 1842.

## POLAR MAGNETIC EXPEDITIONS.

Sir,—At the solicitation of several of your subscribers I hand you the following, which I shall feel obliged by being inserted in your valuable publication.

I am, yours truly,

GEORGE TOWLER.

Norwich, October 4, 1842.

### *Polar Magnetic Expeditions.*

These expeditions must unquestionably prove failures, as far as the main objects they have in view are concerned. The natural difficulties to be encountered in those climates preclude the possibility, even of detecting error, or the fallacy of the opinion of the earth's magnetic influence would have long since been confirmed.

The earth has no magnetic power, consequently, it has no magnetic poles.

The magnetic poles are points in the heavens, which points are where the maximum and minimum pressures are to be found, or where the greatest and least quantities of matter exist in equal spaces, "*in the medium of space.*"

Those points on the earth which are known as the earth's magnetic poles, do not coincide with the earth's poles; and as this is not the case, the earth, in its revolution every twenty-four hours, consequently carries with it those points, which describe a circle round the earth's poles in that period; and which, together with the earth's annual revolution, cause those points NOT *to be found in the same place at the same time, but once in the year.* Therefore, the search for any points on the earth on which the magnetic needle will permanently exhibit the same phenomena which it does when imdiately under the celestial magnetic pole must for ever prove fruitless.

The truth of these remarks can be proved without the necessityof Polar Expeditions, or without travelling out of the temperate zones.

The determining the progression of those points which are called the earth's magnetic poles, and the finding such points at any given time, may be achieved by observations which could be carried on almost at home.

## DREDGE'S SUSPENSION BRIDGES—ANCIENT IRON MANUFACTURE.

Eight bridges on Mr. Dredge's plan of suspension, (see *Mech. Mag.*, vol. XXX. p. 53,) have been now erected, and several others have been ordered, or are now in the course of construction. The Victoria Bridge, across the Avon, at Bath, of 150 feet span, was constructed in 1836; since then, five have been built for the Government, in Regent's-park, London; one across the Leven, Lochlomond, in Scotland, for Sir James Colquhoun, Bart., which is not less than 294 feet in length, and 20 feet wide; and one for G. S. Harcourt, Esq., at Wraysbury, near Windsor, (close to the famous Runnymead,) which is of 100 feet span, and 17 feet wide. The last, which has just been completed, took only three weeks in construction, after the foundation-stone was laid; and the cost has not been half what the mere

centring for a common stone bridge would have cost.

The author of this very ingenious and fast-spreading system of construction, in lately communicating to us the progress of the Wraysbury bridge, makes mention of an incidental discovery, of considerable interest. "In excavating," he says, "the foundations for the bridge, about twenty miles west of London, a considerable number of horses' shoes and nails were discovered, imbedded in a peat bog, several feet below the surface. They were of extremely rude construction, which, coupled with the fact of their being found four feet beneath an ancient road, leaves no doubt of their great antiquity; notwithstanding which, the iron was in the highest state of preservation, and as free from rust as when dropped from the horses' feet, and the marks of the smith's hammer were still visible."

## THE WATER QUESTION—FOUL PIPES AS INJURIOUS AS FOUL CISTERNS.

Sir,—Having observed in the pages of your valuable Journal a discussion between two of your correspondents, respecting the obtaining of pure water—one of whom contends that the Companies ought to filter it properly before it is supplied, and the other asserts that the largest amount of impurity arises from dirty cisterns—it has occurred to me that there is an abundant source of mischief which has been overlooked by both.

The house in which I reside is within a bow-shot of the New River Head, the water from which flows into two leaden cisterns, (one in each kitchen,) which are completely covered up, and secure from any extraneous matter falling in, and are also regularly cleaned out. The water is nauseously earthy to the taste; indeed, so much so as to flavour even the tea, and other beverages made from it.

At a friend's house, which is situated nearly on the opposite side of the reservoir, and at a little further distance than my own, the water, although still perceptibly earthy, is not nearly so bad. This fact at first completely puzzled me. I attributed the badness of my water to the cistern, and accordingly tried the water before it entered it, as it came from the supply pipe, but found it worse. The only reason which I can now give for the difference in the quality of the water at these two points is, that the main and service pipes through which my supply is received have been down about twenty years, while those through which my friend is supplied have only been laid about three.

Whether the Water Companies would consent to take up their pipes, clean them, and relay them at certain intervals, is, I suppose, very doubtful. Indeed, I, for one, begin to despair of being supplied with water even tolerably pure; and would advise every one, who does not wish to drink a nauseous fluid, to filter his own supply. A very efficient filter may be constructed for less than 1s. 6*d.* Hydropathists insist most vehemently upon the necessity of using water which is absolutely pure; and although I do not believe that perfectly pure water exists any where naturally, still, I suppose very few will deny that the constant use of impure water must be detrimental to health.

Yours truly,

W. H.

St. John's-street-road, Oct. 4, 1842.

## THE CRANK QUESTION.

### *A few valedictory words.*

It must be a bad case where a mathematician is driven to the disingenuous necessity of making use of words which can be construed to have an ambiguous meaning, and at the same time will not in any way attempt to give a practical meaning when called on, or indeed explanation of any kind of what the true meaning should be.

In my reply (see vol. xxxiv. page 440) to "R. W. T.'s" paper containing the extract given in his last letter, I stated, that he endeavoured to get out of the difficulty, in which the facts in my experiments had placed him, by contending, that there was some ambiguity about the meaning of the term "*loss of power*," so as to make those experiments, if possible, thereby square with his favourite doctrine; and now, after numerous unsuccessful attempts to prove my experiments inconclusive, he is driven back to take refuge in the same quarter. Was this his reason for refusing to give any practical explanation of his meaning of the term "loss of power," and the cause he was so much perplexed at my doing so? He is not satisfied with the ambiguity of the term above mentioned, but he now wants to extend the principle to the words "*mechanical disadvantage*," and wishes to make it appear that the word "disadvantage," in mechanical science, cannot have the ordinary meaning; though, at the same time, he will not explain what it should be. It does not appear that these blunders are altogether caused by want of understanding the subject, from the turn he has given to the experiment described

by your Aberdeen correspondent. It is unfortunate, however, for that writer, that he has interfered with him, for he has made it appear that he did not know how to calculate the work done by a steam-engine; inasmuch as he overlooked the spaces passed over by the weights.

"R. W. T." ridiculed, in one of his letters, the idea that a weight of 37½ lbs. could be drawn over a space of 6 inches, when the shifting leverage was removed by a power of 50 lbs. moving 4 inches under the circumstances described; and when I have proved the fact beyond the possibility of doubt, he thinks it strange I should give myself the trouble of proving what every body already knew to be a fact!

Your correspondent is mistaken about the Cornwall engines; there are none of them worked, which *have cranks*, without what he calls an efficient fly-wheel: but if he will read a paper lately published in your Magazine, read before the Institution of Civil Engineers, he will see of what little importance the efficient fly-wheel, of which he thinks so much, really is. A powerful engine wheel employed for grinding corn, he will find, had a fly-wheel, weighing 24 tons, removed, and the consequence was, eleven per cent. increase of work. It is a strange circumstance, that, nearly a century back, the *unscientific* Smeaton gave it as his opinion, that a fly-wheel was a great incumbrance to steam-engine mill work, and that it should be only at the present day found out that his opinion on this head, like that on the crank, is perfectly sound. Perhaps, however, we ought not altogether to wonder at this, when we find mathematicians, and some of eminence even, following the course which it has been the intention of my papers to prove erroneous.

I am, Sir, &c.,

M.

[We hope this discussion may here be allowed to close.—Ed. M. M.]

### THE LATHE.—THE LATE MR. MAUDSLEY'S IMPROVEMENTS.

Sir,—In No. 995 of your last monthly part, is a communication from C. W. Williamson, on his alleged improvement in the Lathe which has lately been adopted in the Dock-yard at Chatham, and for a description of which he refers your readers to No. 24, of the 7th of Feb., 1824. On referring to that Number of your scientific journal, I find a communication from "Charles Williamson," describing an improvement in the lathe, which enables the driving cat-gut band to accommodate itself to the varying diameter or changes of the conical pulley upon the mandril of the lathe as his invention. Precisely the same method as here claimed, was used by the late Mr. Henry Maudsley, the minent lathe-maker, in his manufactory; and it is fully described in Gregory's Mechanics, page 513, published in 1815; which was several years prior to C. W.'s communication. A foot-lathe made by Mr. Maudsley with this identical improvement was in the possession of the late Rev. Wm. Green, of Grimston, Yorkshire, in 1820, who was an excellent amateur mechanic, and took great pleasure in showing it to any applicant, as it was considered the mechanical lion of the neighbourhood.

My only object in writing this is, to put the invention in the possession of its owner, and to pay a tribute to the memory of a justly celebrated mechanic who, by his invention of the slide rest, and various other important improvements, rendered the lathe a most important and automatic machine. As your Magazine is identified with the cause of science and truth, probably you may find room for this communication.

I am, &c.,

J. JOHNSON, Junior.

Leeds, Oct. 7th, 1842.

### CALDERHEAD'S CARPET LOOM.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination an improvement in the Loom for weaving Carpets, &c., invented by Mr. Alexander Calderhead, of Philadelphia, Pennsylvania, REPORT:

That Mr. Calderhead's loom is a material modification and simplification of the Jacquard and other draw looms, for weaving carpets and other figured cloths. It dispenses with all machinery above the working parts of the common loom, and is thereby so reduced in height, that it may readily be placed in a common apartment without requiring the removal of the ceiling. The *harness* consists simply of *heddles*, or heilds, made of wires, about twenty-four inches long, and each pierced with an eye, for a thread of the warp to pass through, in place of the mails, twine, and leads, of the Jacquard harness. The heddles work vertically, in holes through two boards, or plates, resembling cumber-boards, the upper of which may be called the *rest-board*, and the lower the *guide-board*. The heddles have each a head at the top, which prevents their falling through the rest-board, and enables it to raise them when raised itself. The *cylinder*, or trunk, is a four or six-sided long and slender box, with pivots at the ends, and it extends horizontally across the whole width

of the loom directly beneath the heddles; it is pierced on each side with holes corresponding to those of the cumber-boards, and the *pattern-cards*, or apron, rest upon it, and revolve with it—so that when the cylinder is raised and the rest-board lowered, the blanks of the card raise the proper heddles, while the remaining ones drop through the holes of the card, and of the cylinder beneath it, to form the sheed, or opening, for the shuttle to pass through. Thus the width of the sheed is equal to the distance which the heddles penetrate into the cylinder, and the upper and under threads of the warp are stretched alike. The cylinder turns on bushes, in a frame which slides vertically, and which, being raised by levers connected with the treadle, raises the cylinder. But the cumber-boards slide vertically and separately in the same frame, and the cylinder as it rises lifts the guide-board, with a part of the heddles; but the sliding frame acts upon two levers, supported from the cross-beam above, and thereby lowers the rest-board, and allows the proper heddles to descend into the cylinder. The guide-board is suspended from the rest-board, so that it cannot fall too far below it when the cylinder descends; and by means of a wheel at the end of the cylinder—having as many inclined teeth as the cylinder has sides, and these teeth acted upon by a kind of ratchet hooking against them—the cylinder as it descends is turned, so as to bring the next side uppermost, and bring the next figure of the pattern cards into operation when the cylinder is raised again. By means of a like wheel on the other end of the cylinder, its motion may be reversed, and the pattern moved in the opposite direction.

The committee believe the whole contrivance above described to be original, and exceedingly simple, ingenious, and effective, costing less than the machinery for which it is proposed as a substitute, in the outset, and producing a considerable saving in subsequent repairs of the twine required in other harnesses. The inconvenience arising from the stretching of the twine, is in this loom entirely avoided. It is alike adapted for cumber work, where the figure varies throughout the whole width, and point work, where the figure is symmetrical. It may be used for fabrics of two or more plies, or thicknesses, and requires for them merely a single pattern. The only objection to its use which has occurred to the committee, is, that the fly or downy matter from the warp may in time clog the cylinder; but if this should be the case, that part may be easily removed and cleaned out, and there is little reason to apprehend any difficulty from this source. The committee would warmly recommend this invention to all manufacturers of carpets and figured fabrics, while they accord high praise to the meritorious inventor.

June 9th, 1842.

By order of the committee,

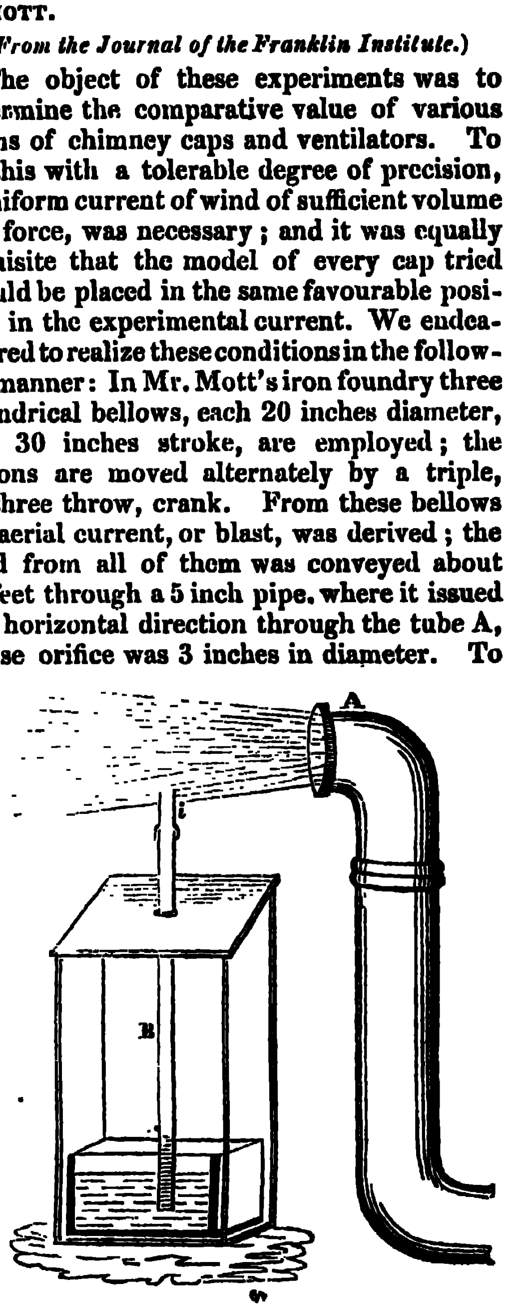
WILLIAM HAMILTON, Actuary.

Journal Franklin Institute.

## ON THE COMPARATIVE VALUE OF VARIOUS FORMS OF CHIMNEY CAPS AND VENTILATORS. BY THOMAS EWBANK AND J. L. MOTT.

(*From the Journal of the Franklin Institute.*)

The object of these experiments was to determine the comparative value of various forms of chimney caps and ventilators. To do this with a tolerable degree of precision, a uniform current of wind of sufficient volume and force, was necessary; and it was equally requisite that the model of every cap tried should be placed in the same favourable position in the experimental current. We endeavoured to realize these conditions in the following manner: In Mr. Mott's iron foundry three cylindrical bellows, each 20 inches diameter, and 30 inches stroke, are employed; the pistons are moved alternately by a triple, or three throw, crank. From these bellows the aerial current, or blast, was derived; the wind from all of them was conveyed about 20 feet through a 5 inch pipe, where it issued in a horizontal direction through the tube A, whose orifice was 3 inches in diameter. To

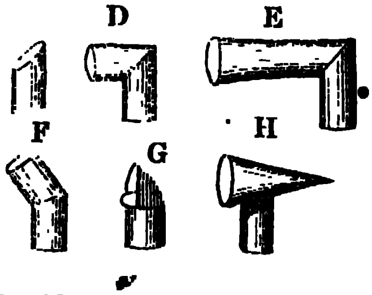



render the blast as equable as possible, the steam engine that worked the bellows was kept going at a uniform speed during the time occupied in experimenting. The blast, however, was not, after all, very uniform, and the consequence was a slight oscillation of the water in the gauge that measured the results.

Eight inches from the open end of the blow-pipe A, a glass tube B, an inch and a quarter bore, and 28 inches long, was secured in a frame. Its lower end descended into a vessel of water, as represented, and to its upper end was fixed a ferrule *i*, of tin plate. To this ferrule the vertical tubes of the caps were accurately fitted, so as to be slipped on and off without disturbing B. The models were made of tin plate, and the vertical tubes attached to them were all of the same dimensions, viz.: $1\frac{1}{8}$ inch long and $1\frac{3}{16}$ inch bore. The glass tube which may be supposed to represent a chimney, was designed, as the reader will have already perceived, to measure the degrees of rarefaction produced within it by the caps—the ascent of the fluid indicating the effect of the blast of wind on each. Except when otherwise noticed, the axes of the caps, or horizontal tubes, were made to coincide with that of the current. With the view of verifying the general results, and to detect any variation in the force of the blast, from slight changes in the speed of the steam-engine, the experiments with each cap were repeated, at short intervals of time, but no very obvious changes in the results here recorded were observed.

*Experiment I.*—The first experiment was with the tube B, as figured in the cut. It was raised till the orifice of the ferrule was in the centre of the blast; but in no part of the current was any rarefaction produced. The water was neither elevated nor depressed within the tube. Had the upper end been inclined towards A, wind would have entered and displaced the water from the bottom of the tube: and, on the other hand, had it been inclined in the opposite direction, a slight ascent of the fluid would have followed; but it was not deemed of sufficient importance to try either.

*Experiment II.*—The tube C was now slipped on the ferrule in the position in which it is figured. It will be perceived



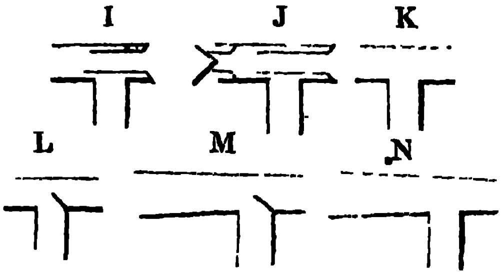

that at the side away from the blast, a portion is removed, as if to form with a similar tube a mitred joint, or a right-angled elbow. With this device the water rose in B from $1\frac{3}{4}$ to $2\frac{1}{2}$ inches above its level in the vessel. By turning the open part of C till it was nearly parallel with the blast, little or no change in the extent of rarefaction took place.

*Experiment III.*—D was next tried. It consisted of two tubes like C, united at right angles. When the horizontal branch was in the direction of the current, the water oscillated in the tube from $1\frac{1}{2}$ to $2\frac{1}{4}$ inches. Upon turning the cap till its axis formed an angle of 45 degrees with that of the current, the liquid column rose to $3\frac{1}{4}$ inches; and when the angle was 90 degrees, the water fell to $2\frac{1}{2}$ inches. An elevation, however, greater than was obtained when the cap ranged with the blast. The cap was next turned to its first position, and a conical tube, 6 inches long and 2 inches diameter at its wide end, added to it, as figured at E. To our surprise, no further elevation of the fluid took place. The central current of the blast being received against that part of the vertical tube opposed to it, was, probably, too strongly deflected to allow other portions of the current to sweep close around the horizontal branch. Had the cap D resembled the one marked F, there can be no doubt of the effect being increased, as the wind would then embrace, and impinge upon, a larger surface. Unfortunately we had not prepared any models of cylindrical caps at various angles, *i. e.*, where the caps proper were inclined upwards like F. The next figure exhibits an approach to this plan, and when compared with C, which it so nearly resembles, exhibits a decided improvement.

*Experiment IV.*—The cap G consists of a vertical tube, with a head piece extending over three-fourths of its upper, or discharging, orifice. The back of the hood, which receives the blast, forms an angle of about 30 degrees with the side of the pipe to which it is attached. This cap raised the water in B from $3\frac{1}{2}$ to $4\frac{1}{2}$ inches, being double the elevation which C produced. Deviating the position of the opening, with regard to the current, diminished the effect.

*Experiment V.*—The conical cap H was now placed in the blast, upon which the fluid ascended in B from $2\frac{1}{2}$ to $3\frac{1}{2}$ inches. Three models of this cap were tried; they were all of the same diameter at the mouth, and the vertical tubes were attached to them at the same distance from the mouths, viz.: $\frac{3}{8}$ths of an inch; but their lengths varied, being respectively 3, $3\frac{3}{8}$, and $3\frac{7}{8}$ inches. There were no very observable variations in the altitude of the liquid column produced by them, but the only one that raised it to $3\frac{1}{2}$ inches was the longest—the one last named. When the mouths were turned till the axes of the cones formed an angle of about 45 degrees with that of the blast, the water commonly fell in the tube, though not uniformly so; but what appeared singular, when the axes of the cones were at 90 degrees with the current, the water actually rose to $4\frac{1}{2}$ inches! On several trials this unexpected result followed.

*Experiment VI.*—The next experiment was with the cap figured at I. The model




was made from caps on sale in the city. The outer pipe, or case, was 4⅝ inches long and 1½ inch bore. The inner tube was ⅜ths of an inch bore, and with the conical ajutage to catch the wind, 2½ inches long. This cap raised the water 1½ inches. When its axis was a little inclined to the blast, no sensible change in the elevation of the water in B followed; but when the angle with the axis of the blast was at 45 degrees, the water fell to 3½ inches, and at 90 degrees the water stood only at ½ an inch. (This, and the remainder of the figures, are in section.)

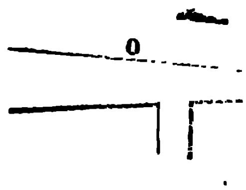
*Experiment VII.*—The inventor of the last cap has applied near its open end (by two or three strips) a cone, as represented at J. The object of this is to prevent currents of wind entering that end, and so driving the smoke down the chimney, instead of drawing it up. To ascertain the effect of this arrangement on the exhausting power of the cap, the model J was made in all respects the same as I, the cone excepted. On applying it to the current, the water rose in B to an elevation little more than half of that produced by I, being only 2½ inches. When the cap was turned to 45 degrees, the water fell to 1¼ inches, and at right angles it sunk to a level with that in the vessel. This effect might in some degree have been anticipated, since the wind would, in being thrown from the sides of the tube, be apt to catch hold of the cone, and be turned into the cap. On this account, the base of the cone should not project in the least degree over the mouth. The cone, too, retards the free exit of the smoke.

*Experiment VIII.*—The next devices tested were such as I have applied to charge siphons, and also for producing a vacuum by currents of steam—the model marked K consisting of a horizontal and perpendicular tube of the same bore, united at right angles. The horizontal one was 2½ inches long. On placing this cap on the glass tube, no rise of the water took place, but rather the reverse, for portions of wind descended and drove out the water occasionally. When the axis was inclined nearly 45 degrees to the blast, the water *rose four inches.* At right angles it was two inches.

A projecting piece was now placed within the cap, so as partly to cover the orifice of the perpendicular tube; (see next figure, marked L.) On trying this, the water rose 4½ inches; inclining the cap raised it to 5½ inches; as the projecting piece retarded the current through the tube, it was pressed down to make the passage way larger, upon which the water rose a little higher. Various conical ajutages were now tried, as figured at M, and with one 6 inches long, and 2 inches diameter at the wide end, the water rose 8½ inches. No additional rise of the column was obtained by changing the position of the cap within the current.

*Experiment IX.*—The same cap was now tried again, but with the projecting piece entirely removed, (see N.) The water now rose 15 inches, and oscillated from 13 to 15. A short conical tube, whose mouth flared out to 2 inches, was next inserted into the small end of the cap, with a view to draw more air through it; this caused the liquid column to ascend at once to 18 inches. A longer tube, whose mouth reached to the orifice of A, caused the water to rise entirely out of the tube—28 inches! These increased defects, it will be remembered, are caused by an *interior and exterior* blast—the wind sweeping *over*, as well as *through*, the cap.

*Experiment X.*—A cap, precisely the same as the last, except the horizontal one, being 1½ inches bore, and as figured at O, raised the water to 18 inches, and kept it oscillating from 16 to 18. The short diverging mouth




piece mentioned above, was applied to the receiving end of the cap, and raised it from 22 to 24 inches!

From these experiments it would seem that a chimney cap, or ventilator, made like the last figure, is very far superior in its effects to any other yet known; and, what is of some consequence, the form is almost as simple as the simplest. A diverging tube might be attached to the end which receives the current, but the mouth of this should not greatly exceed the diameter at the junction with the vertical tube; if it did so, it would diminish the effect of the wind, in sweeping along the sides of the discharging branch. The under side of the receiving end of the cap should project beyond the upper one, in order to catch the descending currents more readily. This feature is figured at N and O.

Perhaps some readers of the Journal may find time to repeat and extend these experi-

ments. There are several old chimney caps which have not been included, especially *revolving* ones At the first favourable opportunity, we will, if not anticipated, pursue the subject.

## INSTITUTION OF CIVIL ENGINEERS.

June 28, 1842.

"*Description of the mode adopted for sinking a Well, at Messrs. Truman, Hanbury, Buxton, and Co.'s Brewery.*" *By Robert Davison, M. Inst. C. E.*

The author commences this communication, by stating that one of the principal objects of the brewers, is to obtain a constant supply of water at a low temperature, for the purpose of cooling the worts, particularly during the summer months. The quantity of water to be obtained from the land-springs has (he says) been represented as not to be depended upon; this would probably be correct, if required, as frequently proposed, for the supply of all the wants of a city, but if a well is properly sunk, there can be no doubt of obtaining a supply of 80 to 100 gallons per minute.

With regard to the quantity of water obtainable from the chalk stratum, the author believes it to be more precarious, for while instances occur occasionally, where a considerable opening is found in the chalk and a plentiful supply is obtained; the cases it is believed are as frequent where fissures are not met with and a failure ensues.

He then proceeds to give a narrative of the facts which occurred during the progress of an attempt to sink a cast-iron cylinder from the surface down to the chalk, a depth of about 200 feet, intending to admit the springs at the different levels, as might be considered most advisable.

The well was commenced in the middle of a landspring well 16 feet diameter, and in order to avoid the usual inconveniences of pumping and excavating, Mr. Clark of Tottenham performed a large part of the work with the "miser" instead of by the usual methods of well-sinking.

The landspring well was drained January 25, 1839, and the excavation of a well 11 feet diameter was commenced; this was carried down of a clear diameter of 8 feet 6 in. inside the brick steining, and when it had arrived at the depth of 115 feet 3 inches, the first cast-iron cylinder was lowered, and others were gradually added, shutting out the springs as they were passed, until April 3, when, at the depth of 135 feet, in a bed of yellow clay and pebbles, the water overpowered the excavators, and after trying many methods of continuing the excavation, the use of the "miser" was resorted to, when the cylinders had gone down to 144 feet. On the 11th of May the oyster bed was reached, at 163 feet depth; and after some deliberation, it was resolved to continue sinking down to the chalk. For seven days the men were employed in "jumping" a heavy chisel bar to break through the hard rocky crust of this oyster bed; at length between the 25th and the 27th of May the cylinders suddenly sunk 5 feet 6 inches; the misering was continued until the depth of 189 feet ten inches was attained, and the cylinders were found to be completely fixed. A pressure of nearly 100 tons applied by powerful screws was tried without producing any effect; it was therefore determined to fill all the space between the steining and the exterior of the cylinder with concrete, although a portion of the steining was discovered to have given way; it was supposed that the cylinders would have been held up by the pressure against the steining and the earth; the pump-work was therefore fixed, and after a time the pumping commenced; on the 21st October, after no more than the usual pumping (the water generally containing sandy sediment), it was observed that the pavement around the well had given way; the machinery was stopped, and immediately there occurred a rumbling noise within the cylinders which lasted probably 4 or 5 minutes; on examination, it was found that the cylinders had sunk 4 inches, the main girders across the top were broken, and on sounding the well it was discovered that an extensive "blow" of sand had taken place, and filled the bottom of the well for nearly 28 feet; this was cleared out by misering, and after recommencing pumping for some time, on the 14th December a separation of the cylinders about 2½ inches wide was discovered at about 73 feet from the surface. Mr. J. Braithwaite and Mr. J. Simpson were consulted as to the best method of proceeding; the former was of opinion that there was such a subsidence behind the cylinders, as would endanger the safety of the surrounding buildings. The latter did not take so serious a view of the matter; but he suggested the sinking of an internal cylinder, if the original one could not be forced down.

After this examination, a portion of one of the cylinders was cut away at 72 feet from the surface, where the soft part of the clay commenced, and a dome was constructed with brick and cement all round the exterior of the cylinder, with the intention of supporting the brick steining and strata above, and also to carry off the water, and prevent its softening the clay and the concrete.

On the 18th of March, 1840, an internal

cylinder of 2 feet diameter was lowered, within the original cylinder, and continued sinking until it reached the chalk, into which it was driven four feet; the space between the large and small cylinders was then filled in with granite paving stones for 5 feet in depth, and then with smaller stones, broken bricks, &c. mixed with hydraulic cement, to the depth of 25 feet, thus forming an effectual barrier against any future "blow" of sand from the original bottom of the well.

After all was imagined to be secure, and the pumping had recommenced, a second separation to the extent of 4 inches was discovered in the cylinder; the gap thus formed was first filled in completely with wooden wedges, and a cast-iron cap was afterwards bolted withinside. The well was then drained, and 400 holes ½ inch diameter were drilled in the cylinder, immediately beneath the oyster bed, to admit the water from that level. It was ascertained also by experiment, that the quantity of water obtained from the 2 feet bore in the chalk, was about 22 gallons per minute; the bore was then continued for a depth of 200 feet, making the total depth of the well and the bore from the surface, nearly 400 feet, when a supply of water was obtained of 33 gallons per minute; some of the joints of the cylinders were then picked out, to admit the water, and from all the sources combined, the quantity of water obtained was about 81 gallons per minute, or 135 barrels per hour; that is, 55 barrels from the chalk spring, and 80 barrels from the sand-spring per hour.

The cost of the well and the bore was 4444*l*., to which must be added the expense of a 12-horse steam-engine and pumps 1351*l*., making a total cost of 5795*l*.

Appended to the paper is the report of Mr. James Simpson, which gives a very clear account of the state in which he found the well, and the remedies which he suggested for the accidents which had occurred.

It is illustrated by two drawings, showing in detail a vertical section of the well, with all the pumps and machinery, and also the tools used in the excavation and the bore.

### TELFORD AND WALKER PREMIUMS.
### *Session* 1843.

The Council invite communications on the following, as well as other subjects, for Telford and Walker premiums :—

1. The original cost, annual expense, and durability of Timber Bridges, compared with similar structures in Stone, Brick, or Iron.

2. A Description of the Canal of the Helder (Holland,) or of any Foreign Engineering Works of a similar kind and importance.

3. The modes of Irrigation in use in Northern Italy; of Drainage adopted in the Lowlands of the United Kingdom, or works of a similar nature in Holland, or in other countries.

4. On any of the principal Rivers of the United Kingdom, (the Shannon,) or of Foreign Countries, (the Po, Italy,) describing their physical characteristics, and the engineering works upon them.

5. An account of the waste or increase of the Land on any part of the coast of Great Britain, the nature of the Soil, the direction of the Tides, Currents, Rivers, Estuaries, &c., with the means adopted for retarding or preventing the waste of the land.

6. The various kinds of Limes and Cements employed in Engineering Works.

7. The best and most economical mode of raising large Stones or Rocks from the beds of Rivers or Harbours.

8. The conveyance of Fluids in Pipes, under pressure, and the circumstances which usually affect the velocity of their currents.

9. The means of rendering large supplies of Water available for the purpose of extinguishing Fires, and the best application of manual power to the working of Fire Engines.

10. The most advantageous method of employing the power of a Stream of Water, where the height of the fall is greater than can be applied to Water Wheels of the usual construction.

11. The construction of large Chimneys, as affecting their draught; with examples and drawings.

12. On the ventilation of Coal Pits or Mines in Great Britain, or in Foreign Countries.

13. The relative merits of Granite and Wood Pavements and Macadamized Roads, derived from actual experience.

14. The smelting and manufacture of Copper.

15. The smelting and manufacture of Iron, either with Hot or Cold Blast, in Great Britain or in Foreign Countries.

16. The comparative advantages of Iron and Wood, or of both materials combined, as employed in the construction of Steam Vessels; with drawings and descriptions.

17. The sizes of Steam Vessels of all classes, whether River or Sea-going, in comparison with their Engine Power: giving the principal dimensions of the Engines and Vessels, draught of water, tonnage, speed, consumption of fuel, &c.

18. The various mechanism for propelling Vessels, in actual or past use.

19. The description of any Meter in practical use for accurately registering the quan-

tity of Water for supplying Steam Boilers, or for other purposes.

20. Deductions from direct experiment of the degree of condensation which is most favourable for the working of Steam Engines, as regards the production of mechanical power, stating the inconveniences resulting from the use of Steam at a high pressure, and showing how such inconveniences may be remedied; with simple rules for indicating the proper temperature of the discharged water.

21. The various modes adopted for moving Earth in Railway Tunnels, Cuttings, or Embankments, with the cost thereof.

22. On Stone Blocks and Timber Sleepers or Sills, with or without continuous Bearings, for Railways.

23. The results of experience as regards the consumption of Power for a given effect, on Railways having different widths of Gauge; with the advantages or disadvantages attributable to any established width of Gauge.

24. On the forging of Solid Axles for Locomotive Engines and Railway Carriages, which are subjected to great strain, noticing particularly whether the Iron used be of a cold-short or red-short quality, the relative strength of the two qualities, and whether the size of the Crystals appears to influence the cohesive strength of the metal.

25. The advantages of large and small hollow Wrought Iron Shafts for Machinery, Axles for Carriages, &c., the best mode of manufacturing them, and the formulæ for computing the strength.

26. Memoirs, and Accounts of the Works and Inventions of any of the following Engineers:—Sir Hugh Middleton; Arthur Woolf; Jonathan Hornblower; Richard Trevithick; and William Murdock (of Soho).

Original Papers, Reports or Designs of these or other eminent individuals are peculiarly valuable for the Library of the Institution.

The Communications must be forwarded, on or before the 31st of May, 1843, to the House of the Institution, No. 25, Great George Street, Westminster, where copies of this paper, and any further information, may be obtained.

CHARLES MANBY,
*Secretary.*

25, Great George-street,
Westminster, 1842.

*Extracts from the Minutes of Council, Feb. 23, 1835.*

"The principal subjects for which Premiums will be given, are

"1st. Descriptions, accompanied by Plans and Explanatory Drawings, of any Work in Civil Engineering, as far as absolutely executed; which shall contain Authentic Details of the Progress of the Work. (Smeaton's Account of the Eddystone Lighthouse may be taken as an example.)

"2ndly. Models or Drawings, with Descriptions of Useful Engines and Machines; Plans of Harbours, Bridges, Roads, Rivers, Canals, Mines, &c. Surveys and Sections of Districts of Country.

"3rdly. Practical Essays on subjects connected with Civil Engineering; such as Geology, Mineralogy, Chemistry, Physics, Mechanic Arts, Statistics, Agriculture, &c.; together with Models, Drawings, or Descriptions of any New and Useful Apparatus, or Instruments applicable to the purposes of Engineering, or Surveying."

## RECENT AMERICAN PATENTS.

[Selected and abridged from the *Franklin Journal.*]

HARVESTING MACHINE, FOR CUTTING, THRASHING, AND WINNOWING GRAIN. *Damon A. Church.*—On the forward part of this machine there is a set of V-shaped cutters, with points that separate the heads of the grain from the straw; above these cutters there is a gathering-wheel, with strips that reach from end to end, to catch the heads of the grain, as the gathering-wheel revolves, and force them against the V-cutters, which separate them from the stocks. The heads of grain are delivered from the cutters on to an endless apron, which extends along behind the cutters, until it arrives at a point where it meets two endless aprons, between which the grain is conducted up to a thrashing machine, of the usual construction; from the thrashing cylinder the grain and straw are discharged on to an endless apron of netting, with meshes sufficiently small to prevent the passing through them of the thrashed heads, but allowing the grain to fall upon another endless apron, which carries it back, until it falls down in rear of a fan-wheel, by which the chaff and dirt are blown out, whilst the grain descends into a box. The cutters are each hung upon a joint-pin at the heel, and are borne up against the gathering-wheel by a spring.

The claim is to the "manner of constructing the knives or cutters, so as to hang each of them upon a rod, or joint-pin, whilst they are each sustained by a spring, as described." Also, to the combination of the apron that receives the grain from the gathering-wheel, with those that conduct it to the thrashing cylinder; and, finally, to the endless apron of net-work that receives the

grain, &c., from the thrashing cylinder, with the one that conducts the grain to the fan.

Improvement in Mill Spindles and Vertical Shafts. *Jacob Staub.*—The patentee says:—"The object which I design to obtain by my improvement is, to have less friction, and to give better opportunity to repair the end of the spindle."

At the bottom of the step, or ink, there is a movable plug, which runs up into a hole made in the bottom of the spindle or shaft, the upper part of the said hole being occupied by another movable plug, which has a small hole through its whole length, to receive and conduct oil from the box in which the whole works—the oil escaping through a lateral hole in the lower end of the shaft or spindle. As the whole weight of the shaft rests on these two removable plugs, the wear will be confined to them; and when worr, they may be removed, and replaced by others, simply by taking out the spindle.

Hot Air Furnaces and Fire-grates. *William H. Whiteley.*—The claim in this instance refers throughout to the drawings, and is therefore omitted. It is confined to two improvements, the first of which consists in an arrangement of flues for heating the air that is to be conveyed to the apartments to be heated; and the second, to an arrangement of the grate, in combination with a catch, which answers the double purpose of holding the grate in its place, and of scraping off the cinders in cleaning out the fire chamber.

The fire chamber is surrounded by two concentric cylinders, except where the door is placed for the admission of coals, &c., with a space between each, the inner cylinder being pierced with holes. The fire chamber is covered by a plate, in which are inserted tubes for the passage of the draught, and of the air to be heated. The cold air is admitted into the outer space around the fire chamber, from which it passes, through the holes in the inner concentric cylinder, to the chamber surrounding the fire cylinder, thence into some of the flues above the fire chamber, which are surrounded by the draught flues, that carry off the gaseous products of combustion into the chimneys; and the heated air is conducted by pipes, governed by dampers, into the apartments to be warmed.

The grate is made with side-pieces, or cheeks, of a wedge-like form, that slide on inclined bed pieces, and the catch, which holds the grate in its place, is hinged to the furnace, directly in front of the grate, and catches in a mortise made for that purpose. When the grate is drawn out, the catch drags over the top of the bars, and clears off the cinders.

Argand Lamp, for burning Spirits of Turpentine, &c. *John S. Tough.*—"The reservoir and burner are made in the usual manner of Argand's lamp, except the outer cylinder of the latter, which is made about an inch higher than the inner cylinder, and slightly flaring outward. The principal improvements are in the construction and arrangement of a sliding cylinder, which fits the inner cylinder of the Argand burner, having its upper end enlarged, so as to fit the space between the inner and outer cylinders of the burner being flared outward, so as to press the wick against the inside of the outer cylinder, which is also made slightly flaring outward, as before noticed, provided with a funnel-shaped button, or inverted conical regulator, which slides up and down, for concentrating the air around the flame, and increasing its intensity, and a glass globe, with a circular rim inside the same, made in the form of a hollow frustrum of a cone rising inward from the lower rim of the globe, for contracting the space and impinging the column of air around the flame; the slope of said flanch extending downward from the flame, outside the wick, whilst the slope of the button extends also down from the flame, but inside the circle of the wick.

"What I claim as my invention is, the combination of the conical rim, at the bottom of the globe, with the inverted cone regulator, or button, and adjustible cylinder, adapted to, and combined with, the wick case, as set forth."

Machine for Moulding and Pressing Bricks. *Waldren Beach and Ephraim Lukens.*—In this machine the moulds are arranged in a horizontal wheel, and pass under a hopper, from which they receive the tempered clay; they then pass under a pressing roller, which is in connexion with the hopper, its sides embracing thrt portion of the roller which presses the clay. As the moulds advance, they pass under a knife, which is hung to an arbor and is pressed upon by a spring, which knife cuts off the surplus clay, whilst it yields in the event of meeting with a stone. A projection from the under surface of the pistons that form the bottom of the moulds is acted upon by an inclined plane, that forces the bricks out of the moulds, and then, as the wheel continues to rotate, the bricks are, by means of a guide, delivered on to a belt, by which they are carried off to any desired place of delivery. After the moulds have been emptied, they pass under a rotary sieve to be sanded, and thence to the hopper. The filling of the mould is effected by two pallets, called by the patentee "cams," each of which is hung to a shaft that passes across the lower part of the hopper, and through

its side, and is there connected with a weighted lever, which lever projects from the shaft in the same direction with the pallet. The axes of these pallets being above the surface of the mould-wheel, the weighted levers will cause their extreme ends to bear on the surface of the wheel, and as the moulds pass under, the clay is forced into them by the inclined surface of the pallets. The axles of the pallets are provided on one side with a knife, to cut off the clay to the proper width.

MAINTAINING POWER TO DRIVE MACHINERY. *Stephen P. W. Douglass.*—The object of this machine is to receive and regulate any irregular or intermitting power, obtained from any source, and to give it out regularly, as may be required. Two endless chains, placed side by side, are each passed around two wheels, placed one above the other. A pinion, attached to a suitable sliding frame, is situated between the two chains, with its teeth taking into their links; and to this sliding frame is suspended a heavy weight. The irregular or intermitting force is applied to the shaft of one of the wheels, acting on either of the chains, which, by its operation on the pinion, winds up the weight, provided the other chain be held permanent; but as this weight tends to turn this chain, one of its wheels is connected with, and actuates, any machine requiring to be moved with regularity. If the power applied be equal to that given out, the pinion, with its weight, will remain in the same position, and will simply transmit the power which it receives; but if the former exceeds the latter, the pinion and weight will be raised, and when the former becomes less, then they will sink. In this way it will be seen that the winding up of the weight does not prevent it from giving out its full force, as it is always suspended to the chain which gives out the power.

IMPROVEMENT IN THE WINDMILL. *William Zimmerman.*—This patent was obtained for a mode of regulating the inclination of the sails, as the wind increases or decreases, by means of "the centrifugal governor." The sails of the windmill are all connected with a disk, at one end of a sliding rod, which rod passes through the centre of the shaft of the sail wheel, it being made hollow for that purpose; the end of the sliding rod opposite to the disk is provided with a rack, said rack being acted upon by a pinion that receives its motion from the slide of the governor. The increased velocity of the wind wheel will throw out the balls of the governor, which, by their connexion with the sails by means of the sliding rod and disk, increases their inclination, and thus lessens the action of the wind upon them, and consequently retards the motion of the mill.

MACHINERY FOR HOISTING WEIGHTS, &c. *John B. Holmes.*—In this machine the rope, or chain, to which the weight is suspended, winds around two grooved drums, to each of which there is attached a cog-wheel, mashing into a pinion that lies between the two, and by which they are actuated, the two cog-wheels having the same number of teeth, to insure the same motion to the two drums. These drums, together with their cog-wheels, project outside of the frame, one of them turning on a spindle attached to the side of the frame, and the other on a spindle which passes entirely through it—the part of it which is within the frame being adapted to receive one of a train of wheels for multiplying the power. One of the drums has cogs cut upon its outer edge, which take into the teeth of a pinion on the axle of a grooved roller, for the pupose of making pressure upon the rope, or chain, to prevent its slipping.

TURNING STRAIGHT, CURVED, OR TAPER WORK. *Stacy Costill.*—The piece of wood to be turned is fixed to a mandril, and passes through a hole in a plate attached to a slide rest. The hole in the plate is provided with three segments that slide in radial grooves made in the plate for the purpose of regulating the size of the hole to suit the size of handle required to be turned. The segments are all moved together by a second plate, which has three eccentric grooves cut in it, that receive projections from the back of the said segments. The turning of the last-mentioned plate, at the back of the main plate, will, therefore, cause the segments to approach or recede from the centre. The cutting is effected by a cutter attached by proper fixtures to one of the segments.

IMPROVED BEE-HIVE. *James Le Pataurel.*—The proposed improvement is in that kind of hive in which the honey is formed in glasses, and by which the patentee says he is "enabled to take out the honey, &c., from the hive, without destroying the bees, and without running any risk of being injured by them." The glasses are made with a stem, which fits a hole in the cover of the hive, and are provided with a hole at top, and they are arranged in pairs, at a suitable distance apart, to receive two pipes that branch out from a furnace for generating smoke. When it is desired to drive the bees from a set of glasses into the apartment below, the pipes are applied to the glasses, and a composition, consisting of 3 oz. of sulphur, 4 oz. of pitch or tar, $1\frac{1}{2}$ oz. of tobacco, and $\frac{1}{4}$ oz. of grease, is put into the furnace, which generates a smoke that expels the bees. The glasses are then removed, and the holes closed

by means of movable covers. When it is desired to drive the bees from one apartment to another, the pipes of the furnace are introduced through holes in the cover of that apartment from which they are to be driven.

IMPROVEMENTS IN MARINE STEAM-ENGINES. *Charles W. Copeland.*—The cylinders, in this arrangement of the engine, are inclined at an angle dependent upon the depth of the hold, and the length of stroke, and they are fastened to inclined beams, extending from the paddle-wheel shaft to the kelsons, said beams being connected with the kelsons, along their whole length, by other beams, and by bolts—the whole constituting truss-frames, which sustain and divide the weight and jar of the engines. The condensers are directly under the upper end of the cylinders, and the channel-plates run between the kelsons. The lower end of the air-pumps, which are inclined, as well as the cylinders, are secured to the ends of the said channel-plates, and the hot wells to their upper parts; the delivery valves are placed on the upper side of the channel-plates. The pistons of the air-pumps, in this arrangement, are solid; and the whole apparatus is rendered compact, and placed within the reach of the engineer. The side pipes are placed above the cylinders, the steam chests at each end thereof, and the valve stems running down in front of the heads of the cylinder to the rock shaft. The feet are attached directly to the stems, instead of lifting-rods, and are acted upon by the toes of the rock shafts, the two rock shafts being connected together by a rod.

LAMP FOR BURNING OIL AND CAMPHINE. *Christian and Charles Richman.*—The wick tube of this lamp, which is on the principle of the Argand, is provided with two holders that are jointed to the lower end of the tube, their upper ends being semi-circular, and made to hold the wick against the upper end of the said tube. This holder slides on the inner cylinder of the lamp, a pin on its inner side passing into a groove on the outside of the cylinder; and on the outside of the holder is placed the runner, which has a spiral groove running from its upper end to near the bottom, into which fits a pin from the wick-holder, so that by turning the runner, the wick-holder will be made to rise or sink vertically. The upper end of the runner is connected with the glass holder. The button is made conical, and of glass, instead of being flat and of metal.

SPARK ARRESTERS FOR LOCOMOTIVE AND OTHER CHIMNEYS. *W. W. Hubbell.* Four different spark arresters are described. 1. In the first apparatus, the spark arrester and the receptacle for the sparks, instead of surrounding the chimney as usual, is placed alongside of it, and they are made to communicate with each other at or near, the top —the latter being of greater diameter than the former. Within the tube of the spark arrester there is a perforated tube of less diameter and length, so as to leave a space all around, between the two, and at the bottom. The perforated tube, where the arrester receives the draught, smoke, sparks, &c., is covered with solid sheet metal, for the purpose of scattering the sparks. The top of the chimney is provided with a cap, which may be removed whenever it is not desired to make use of the arrester. The space between the outer and the inner perforated tube is covered, so that the draught must pass through the perforations in the inner tube, the sparks being retained in the space between the two. By this arrangement, we are told by the patentee, that "the chimney is not rendered top-heavy, a less surface than usual is exposed to the action of the wind; advantage is also derived from the large surface of the casing which is exposed to the action of the external air, which condenses a portion of the exhaust steam which is passed into the chimney as usual, and is forced along with the sparks, into the space between the outer and inner tubes." 2. The chimney, in this arrester, is surrounded by a perforated cylinder, and the whole by a jacket, which extends down lower than the said perforated cylinder, but not quite so low as the chimney. The chimney is provided with a movable cap, as described in the preceding notice; and the space between the perforated cylinder and jacket is permanently covered with a cap. Near the top, the chimney communicates with the outer space, by means of pipes that pass through the perforated cylinder, so that the draught passes from the chimney into the outer space, and thence, through the perforations in the cylinder, into the space between the chimney and perforated cylinder, and out at the top. 3. In this instrument, the smoke box is surmounted by a drum, and upon this is placed the chimney, which is connected with it by means of a hinge, to admit of passing under bridges, &c. Within the drum is placed a cylinder of perforated metal, or wire gauze, which is closed at its lower end by a plate of solid metal, with a hole in the middle, surrounded by a flanch projecting downwards, for the reception of the exhaust steam pipes, the upper end of the said cylinder being left open. Within the drum there is a belt, or zone, of perforated metal, or wire gauze, united with it at its lower end, and which extends up conically and is united with the upper end of the perforated cylinder, by an annular plate which closes the space between the two. In the space be-

tween the perforated cylinder and zone, there is an imperforated casing, or tube, which extends from within a short distance of their upper ends, to the top of the fire box, a part of it being within, and the rest below the drum, the lower end of which is inclined and connected with the said case by an annular plate, that forms an inclined plane, to cause the sparks which fall upon it to descend into a box at the side. There is an inclined pipe which runs down from the inclined lower end of the drum to the box or receptacle for the sparks; this pipe is divided into two parts by a perforated diaphragm, extending its length, and dividing it into an upper and lower space; the upper space being connected with the upper part of the drum by a pipe. Within the perforated cylinder is an imperforated tube, open at both ends, (and supported by stays,) for the purpose of directing the exhaust steam immediately up the chimney, and to prevent it, by its expansion, from impeding the passage of the draught through the perforations in the cylinder. 4. The patentee says:—"I have combined a horizontal spark arrester and flue with a vertical chimney, which chimney may, in most cases, be made so short as not to require to be turned down, but which may, if desired, be attached to the part constituting the arrester by a hinged joint, and may then be turned down with facility. The horizontal flue that is combined with the spark arrester may be considered as constituting a part thereof, and it is likewise to be considered as forming a part of the chimney; this horizontal flue I sometimes surround by the perforated sheet metal, or wire gauze, by which the sparks are to be arrested."

## SHIP BUILDING.

A most ingenious model has fallen under our observation, of which Captain Drew (the destroyer of the piratical Caroline) is the inventor, for strengthening ships of war, so as to make it all but impossible they shall become hogged. To steam-vessels of the larger class the adoption of this simple and comparatively inexpensive machinery will prove of most vital importance. The immense weight of the engines requisite for a steam-ship render her more than ordinarily liable to break amidships. Captain Drew's plan was, we are told, suggested by the ingenious and admirably effective operation lately performed on the Penelope.

The grand feature of his project is to relieve a steam-vessel from the vast weight of machinery amidships, and to throw it upon two distant parts of the ship, much more capable of sustaining it; and if there be any one vessel to which such an adjunct will be more especially necessary than another, it is the Penelope, whose machinery will be placed exactly in the space occupied by the 60 feet of timber which remains to be added to its length. Captain Drew's plan consists of two longitudinal pieces of timber firmly trussed together, constructed on something like the principle of the arch of a bridge, which will be capable of bearing an immense weight. These bearers are to be covered by a platform for the machinery of four-inch plank; so that the strongest part of the vessel will, in future, be that which has hitherto proved the weakest. It is well-known that the unfortunate President was broken-backed before she left the British Channel on her last trip, from the immense weight of her machinery amidships—the undoubted cause of her melancholy catastrophe. The owners of the British Queen are, we are told, about to cut her in two, for the purpose of avoiding a similar catastrophe, and it is well-known that the long steam-vessels running in Canada seldom last more than five or six years, from the same cause. If, therefore, Captain Drew's plan should realize the expectations we have formed of it, it cannot fail of proving of most vital importance to the navy at large, and to steam-ships in particular.

We had almost forgotten to notice another important advantage that will be gained by Captain Drew's plan. The circumstance of the machinery being placed upon a platform that will be, to a certain extent, elastic, will obviate in a great degree that constant jar which is so trying to the timbers of a steam-ship, and so inconvenient to its occupants.

We have the greater pleasure in speaking of this invention as we think it deserves, inasmuch as we have understood that Captain Drew has no interested motive in placing it before the public. He seeks no patent, and desires no reward beyond the credit of being instrumental in preserving not only valuable property, but human life, from destruction.—*United Service Gazette.*

## PROGRESS OF THE ANTHRACITE IRON MANUFACTURE IN AMERICA.

[From Notes on the Use of Anthracite in the Manufacture of Iron. By W. R. JOHNSON, A.M. Boston, U.S.]

A few years only have elapsed since the introduction of anthracite into extensive use for domestic purposes. A still shorter period has passed since it was held to be a moot-point whether or not this combustible could be used for generating steam; and even after numerous stationary engines, particularly in

Philadelphia and its immediate neighbourhood, had been using this fuel for several years, it was regarded by some as doubtful whether, in steamboats and locomotive engines, it could be substituted for wood. The problem of its applicability to the purposes of the founder, to melt iron in the cupola, has been settled affirmatively for some years —as have all the other points above referred to. For the forge-fire of the common blacksmith it has been extensively introduced. In our anthracite region no other fuel is used for this purpose; and for various manufactures, such as lime-burning, malting, &c., it has been put into considerable requisition. An object of not less importance, perhaps, than any of the preceding, is its employment in the smelting of iron ore in the blast furnace, and the converting of cast, into malleable iron, by refining, puddling, and re-heating.

The making of iron with coke, so long practised in England, Scotland, and Wales, as well as on the continent of Europe, can hardly be said to have yet come into practice in this country. A number of attempts have, it is true, been made to introduce this important branch of manufacture, and, as was very natural, the state of Pennsylvania, abounding throughout a vast portion of her territory with bituminous coal, in immediate contiguity with beds of iron ore and limestone, has been the scene of most of those attempts. The legislature of Pennsylvania, in 1836, passed an act for the encouragement of the manufacture of iron by mineral fuel, giving to the governor authority to charter companies with ample powers in regard to the amount of stock and quantity of land, for the purpose of prosecuting this branch of industry. In the same year, though not under the privileges conferred by this law, a quantity of iron was made with coke, by Mr. F. H. Oliphant, of Fayette county, who sent to the Franklin Institute samples of the metal produced, and of the various materials employed at the furnace. It is understood, however, that this gentleman does not continue the manufacture of iron by coke, probably from the higher value set upon charcoal iron, particularly for conversion into steel, which is carried on at his establishment. It is also probable that, in a region where wood is still abundant and mining labour scarce, the economy of using coke instead of charcoal may admit of some doubt, especially as the cost of machinery and power, to supply blast for coke furnaces, is generally greater than that required for charcoal.

During the years 1835-36 and 37, furnaces were erected at Karthaus and Farrandsville, on the west branch of the Susquehannah river, and at Frozen Run, near the Lycoming creek. At the first of these establishments, several hundred tons of pig metal were produced by coke, but for want of due discrimination in the selection, and care in the preparation of ores, the quality of the product was such as to render it unsaleable, and the works had the farther disadvantage of being placed beyond the reach of the present state improvements, a circumstance, which rendered the transportation of supplies as well as of the metal, too uncertain and expensive. The furnace at Farrandsville was unfortunately placed in regard to ore, the latter being brought by canal from Larrey creek and Bloomsburg, at distances of 20 and 100 miles. The wealthy gentlemen, to whose liberal outlays the erection of this fine establishment is due, have, it is understood, come to the determination to dispose of the same, and thus to relinquish the honour which the friends of our domestic industry had hoped to see them achieve; namely, that of introducing the *profitable* manufacture of iron by means of the bituminous coal of Pennsylvania. The furnace at Frozen Run is well situated in regard to ore, having a 3 feet bed of yellowish white carbonate, as its principal reliance; but the beds of coal in the neighbourhood have not proved so valuable for immediate use, as the heavy forests of timber growing above them; and hence the furnace was found at the last visit of the writer (September, 1839) to be using charcoal, and making therewith excellent pig metal. In this brief reference to coke furnaces in Pennsylvania, it would be unjust to omit mentioning that of Lonakoning, situated on George's creek, in Maryland, a few miles south of the Pennsylvania line, and in the rich coal basin lying between the Savage and the Little Alleghany mountains. When visited, in the beginning of June, 1839, this furnace was making about 70 tons per week of good foundry metal, and every thing betokened a successful prosecution of its operations. It had, however, the misfortune to be situated remote from any available line of public works, and accordingly the expense of bringing its products to market has paralyzed its operations.

On the south branch of Jennings's Run, a few miles north-eastwardly from Frostburg, and in the same coal basin with Lonakoning, two large blast furnaces, on the Welsh plan, for using coke or bituminous coal, are now in progress.

In contrast with this slow progress and languishing state of the coke establishments, we find that within little more than three years, the anthracite furnaces have commanded the attention of many enterprising parties, and that already not less than 11 or 12,

have, in Pennsylvania, been devoted to the prosecution of this manufacture. Three or four more are in contemplation, and will doubtless be speedily erected. Four are either finished or in progress at Stanhope, on the line of the Morris canal, in New Jersey. Those who have clearly understood the character of anthracite, as being the most dense form of mineral fuel, have long perceived the importance of applying it to the smelting of iron. Its comparative freedom from waste by transportation, and its little liability to change by atmospheric influences, have marked it as singularly favourable for use *in furnaces at a distance from the place of its origin.* But the more recent developments in the anthracite formations have proved that it is not, in general, necessary to resort to the expedient of carrying either the coal to the ore or the ore to the coal, in order to be able to make iron with anthracite. If either of these courses of transportation were really necessary, the former would for the most part be preferable, because the weight of ore necessary to produce a given weight of metallic iron, is in general greater than that of the anthracite required for its reduction. Thus, of the rich fossiliferous ore of Bloomsburg, from 2 to 2¼ tons are required to make one ton of iron, while of Wilkesbarre anthracite, from one ton and ten to one ton and twelve hundred weight is the quantity demanded, including what is necessary for heating the blast. When it becomes necessary to use anthracite to produce steam power for blast, the amounts of coal and ore are nearly equal, and the propriety of one or the other course of conveyance, would then be determined by other considerations.

But, to return to the uses of anthracite; it is not merely in the smelting of ores, and the production of pig metal, that our iron manufactures are now affording a profitable employment of this fuel. It has been satisfactorily demonstrated, that the processes of puddling, boiling, and, in subsequent stages of the process, that of heating blooms, slabs, and billets, can all be effected by this fuel alone. This, in fact, with its use, in the smith's fire, carries the metal through every stage, from the ore to the manufactured article, with no other fuel than anthracite.

The methods of boiling and puddling with anthracite have, it is believed, like the smelting of ores with the same fuel, been first invented in this country.* They will doubtless be applied to the conversion into bar iron of other pig metal than that smelted with anthracite, and thus a large demand for the combustible cannot fail to be created.

Among the earliest attempts to use anthracite for smelting iron, may be mentioned that of certain members of the Lehigh Coal and Navigation Company, who, in the year 1820, erected near Mauch Chunk a furnace, intended for that purpose. The first attempt on the Lehigh resulted in nearly the same manner as did a similar trial at Vizille, on the borders of France and Switzerland, under the charge of MM. Gueynard and Robin, where it was attempted to use anthracite either alone or in connexion with other fuel. This last, it is well known, was abandoned in despair of rendering, by this means, the manufacture of iron profitable, and the outlay of 100,000 or 200,000 francs was set down to the debtor side of profit and loss.†

* * * * From the above statements it will be seen, that, whatever can be expected from anthracite of the kind there used, when burned by means of cold blast, was probably realized in the experiments at Vizille. It is certainly possible that, in our Pennsylvania anthracite fields, passing, as they are known

* Dr. Geisenheimer's patent for smelting iron with *anthracite and hot blast*, was taken out, we believe, before anything was effected, in that way, in Wales. This patent is understood to have been bought up by Mr. Crane, and is believed to be the only one, if any, which can avail against the public use of this process in the United States.

This patent of Frederick W. Geisenheimer bears date 19th December, 1833. We take from it the following

*Extracts from the Schedule.*

"*Claims. First*—the application of anthracite coal, exclusively or in part, in deoxidating and carbonating iron ore as above specified and described.

*Secondly*—the application of anthracite coal, exclusively or in part, in combining iron, in a metallic state, with a greater quantity of carbon; if bar iron for steel, if pig or cast iron for a superior quality, as above specified and described.

*Thirdly*—the smelting or reducing of iron ore, so deoxidated and carbonated by the application of anthracite coal as aforesaid, into pig or cast iron.

*Fourthly*—the refining or converting of iron ore, so deoxidated and carbonated by the application of anthracite coal as aforesaid, into malleable or bar iron.

*Fifthly*—the application of anthracite coal as fuel, in smelting or reducing iron ore raw or roasted, but not prepared by a previous separate process of deoxidation and carbonation as above described, into pig or cast iron.

*Sixthly*—Though I cannot and do not claim an exclusive right of the use of heated air for any kind of fuel, nevertheless I believe to have a right to claim and do claim the use of heated air, applied upon and in connexion with the said principle and manner discovered by me, to smelt iron ore in blast furnaces, with anthracite coal, by applying a blast of air in such quantity, velocity and density, or under such pressure, as the compactness or density and the continuity of the anthracite coal requires, as above amply and fully described and illustrated." [*Dated at the city of New York, on the twenty-first day of November*, 1833.]

† An account by M. Gueymard, of the commencement, progress and result of these experiments, was published in the Annales des Mines, vol. iii., 3d series, p. 71; and in the 4th volume of the same work, same series, is contained another account of the same trials, by M. Robin, by whom a part of the experiments were superintended. The latter describes the furnace.

to do by slow degrees, from the extreme dryness of the most compact anthracite, at one end of the coal trough, to a decidedly bituminous coal, with from 12 to 18 per cent. of volatile matter at the other, we may find some intermediate varieties to which the cold blast may be found applicable for the smelting of iron, though the coal be not susceptible of *coking*, and therefore belongs to the class of *anthracites*. Yet the general character of this class is so well represented by the kind used at Vizille, that it appears unreasonable to expect any other result than that to which the French experiments conducted. In those parts of the same coal-fields where the bituminous nature of the mineral is fully established, there seems to be no reason to doubt that the cold-blast and raw-coal system of Dowlas and other Welsh iron-works, may be found entirely applicable. But the French experiments, as well as those previously and subsequently made in Wales, together with those which were undertaken at Mauch Chunk and at Pottsville, before the application of Dr. Geisenheimer's improvement, are salutary cautions to persons who may be inclined to attempt the smelting of iron by true anthracite and cold-blast.

## A COAL WEIGHING MACHINE—TRAVELLERS' PROTECTORS.

Sir,—One of your correspondents who signs his letter " A Wharfinger," wants a weighing machine for heavy commodities, without weights. I beg to refer him to one of my contrivances for such purposes, described in the *Mechanics' Magazine*, in August 1835. A friend of mine (a captain of a large West India vessel) had one constructed for weighing small lots of logwood, varying from 1 to 5 cwt. He told me it succeeded perfectly well. By the by, I think there was a mistake in the references to the drawings which then appeared with my description of the lever and spring balances. Fig. 2 should have been designated fig. 3, and *vice versa*. The attentive reader will ascertain the error, and correct it for himself.

And now for " Door Fasteners," " Travellers' Protectors." Having had very many private applications for information where they can be obtained, and whether I manufactured such contraptions for sale, it may be a satisfaction to those of your readers who may require such a travelling luxury, to learn that it may be obtained of Messrs. Evans and Son, Engineers, 104, Wardour-street, London, and I believe of Mr. Barron.

Yours very truly,

CHAS. THORNTON COATHUPE.

Wraxall, near Bristol, Oct. 13, 1842.

## NOTES AND NOTICES.

*Largest Chimney in England.*—On Monday, the 25th ult., the last stone of a fine specimen of chimney architecture was laid by the spirited proprietor, Mr. Blinkhorn, at his chemical works, Little Bolton. The greatest credit and praise were given by every one who saw this fine chimney, to Mr. Ashton, of Bleakley, who had the construction and management of it. The dimensions are 122½ yards high, 127 feet 6 inches base; 108 feet inside, 21 feet on the top; and it has consumed 800,000 bricks, and 120 tons of stone.—*Blackburn Standard.*

*The Copyright of Designs Act and Sealed Registry.*—The introduction of the qualifying term "fraudulent" (no person shall apply any fraudulent imitation, &c ) will, it is to be feared, render it a difficult matter to procure a conviction under this Act. Were all designs registered under this Act to be made public, or were the registry thrown open to the public, like the registries of the specifications of patents, there might then be some ground for the ordinary legal presumption of previous knowledge; but it is expressly provided by a subsequent clause of this Act, that "with regard to designs whereof the copyright shall not have expired, no such design shall be open to inspection, except by a proprietor of such design, or by any person authorised by him in writing, or by any person specially authorised by the Registrar;" and, in point of fact, it is now the practice of the Registrar not only to keep the registry sealed from the public at large, but even to withhold the titles of the designs registered, of which, before the passing of this Act, regular monthly lists were published. Now, as intent is the essence of all fraud—as there can be no "fraudulent imitation" without knowledge of the thing imitated—it is evident that, under the existing state of things, it will be next to impossible to give evidence of such intent and knowledge. The greater the actual fraud, the greater will be the care to suppress all traces of previous acquaintance with the pirated design. Mere similitude—positive identity even—will not suffice to furnish a just ground for conviction; for what has been done once may be done again, and it is a matter of every-day occurrence to find two persons hitting on the same thing quite independently of each other. Either the word fraudulent should give place to some other more consonant with the spirit of the statute, or the registry should be thrown freely open to the public, so that no person should be at liberty to plead ignorance of its contents.—*Messrs. Robertson and Co.'s Edition of the Act, with Notes, Directions, Tables, &c.*

*Quick Remedy.*—M. Negrier, in a paper lately communicated to the Paris Academy of Sciences, states, that any nasal hemorrhage may be almost instantaneously checked, by raising the arm on the same side as that of the nostril from which the blood flows.



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# Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1002.] SATURDAY, OCTOBER 22, 1842. [Price 3*d*.

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## WHITE'S ELASTIC FRICTION DRIVER.

Fig. 1.

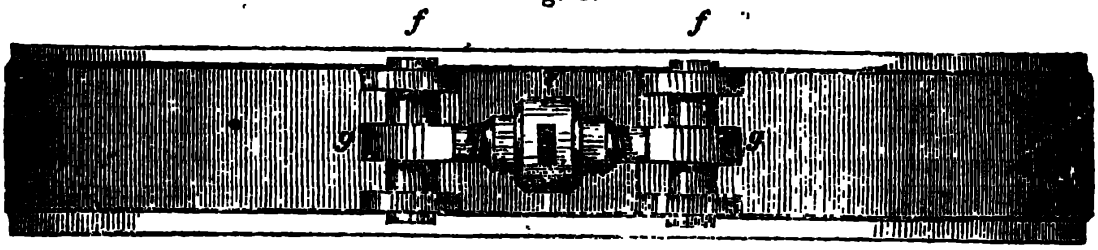
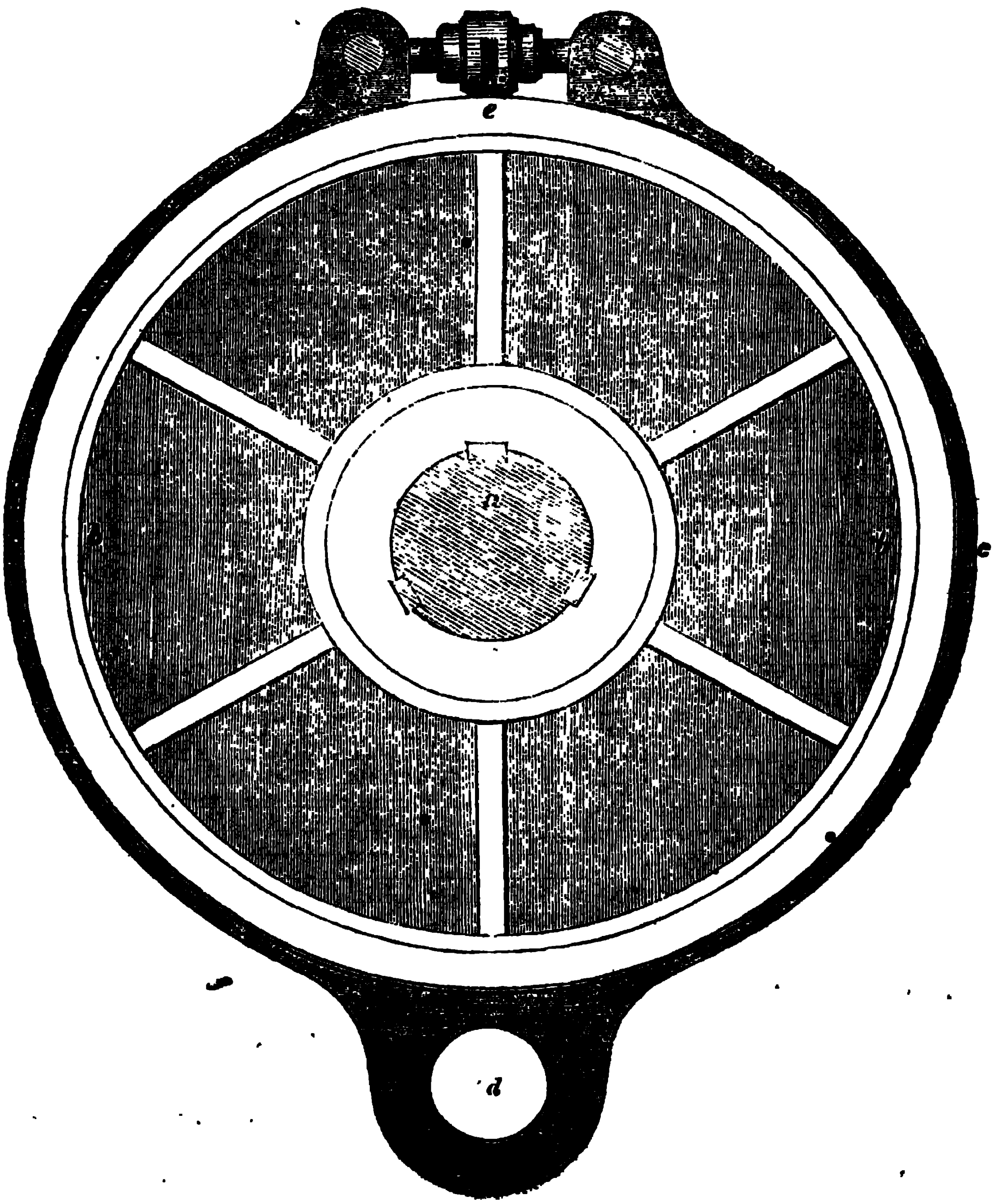



Fig. 2.



## PLAN TO DRIVE PADDLE-WHEELS BY ELASTIC FRICTION, ADDRESSED TO THE DIRECTORS OF THE GENERAL STEAM NAVIGATION COMPANY. BY JAMES WHITE, ESQ., CIVIL ENGINEER.

Gentlemen,—It is not generally known to those concerned with steam navigation, the vast advantage which must result from a simple and efficient plan, which is capable of driving paddle-wheels by *elastic friction;* I therefore take the liberty of addressing this letter to you, as gentlemen possessing a very large interest in the prosperity of marine navigation by steam power.

In general, machines are made to withstand the strain of some estimated quantity of resistance; such, for instance, as raising water, grinding corn, and giving motion to those highly accelerated bodies which move upon railways. With the latter, however, much uncertainty exists; when a locomotive engine runs off the rails, which is not of unfrequent occurrence, the strain on the engine is then prodigious, and rarely happens without being followed by some fearful disaster. Circumstances like these greatly embarrass the engineer to find a proper proportion for the strength of his machine; and although a steam vessel is not liable to run off her way like a locomotive engine, from the immense strength of the machinery which propels her, in comparison with the power required to drive the paddle-wheels; yet, it is evident, the sea-going steamer encounters trials no less to be dreaded, than those which locomotive engines are liable to upon a railway.

The paddle-shaft of a steam vessel having engines jointly of 200 horse power is generally 12 inches in diameter, and the cylinders are each 54 inches diameter; these together present a surface of 4,580 square inches to the united power of the steam vacuum, which is directly the motive power—fire and water the agents to produce it. Now, 4,580 square inches exposed to a pressure of 3 lbs. from steam on the one side of the pistons, assisted by 13 lbs. per square inch from the vacuum on the other, gives an aggregate of 73,280 lbs. pressure.

If the paddle-wheels be making 20 revolutions per minute, and are driven by a crank having a leverage of 30 inches, the orbit of the crank's pin measures 188·49 inches, and the space travelled through in 20 revolutions is 3,769·8 inches; and 21,100 pounds, uniformly pressing the crank-pin round its orbit at that velocity, equals 200 horse power, allowing the usual standard of 33,000 pounds to be lifted one foot high per minute, for 1 horse power. This would be the amount of steady power, the two 54 inch cylinders are capable of performing, supposing the paddles to receive it with a uniform pressure. If, in place of 21,100 pounds as the average force, 36,640 pounds be taken, which is one half of the whole pressure upon the pistons, the strength of the shaft to resist that strain appears ridiculously disproportionate.

One of the rules for ascertaining the ultimate strength a round bar of iron will stand, to resist torsion, is, to multiply the cube of its diameter by 12063, and to divide that sum by the length of the lever in inches, for the weight in pounds avoirdupois. Now this in the present case gives 310 tons, while the shaft being 12 inches diameter, and the lever 30 inches long, 36,640 pounds equals 16·3 tons, or only $\frac{1}{19}$th part of the breaking force.

I am not making these comparisons with the view of advocating slight machinery for marine engines; on the contrary, I consider the above proportions of the shaft nothing too much when exposed to the occasional strains which arise from the present mode of driving paddle-wheels. But surely something must be wrong, when the greatest force the motive power is capable of producing by way of torsion, is only 13·3 tons, and the shaft's power to resist it 310 tons! A fault which is not simply confined to the shaft, but affects the whole machinery of the engines, and cannot fail being a heavy drag to the prosperity of marine navigation by steam power.

When a sea-going steamer is gliding quickly over the surface of an unrippled sea, it is then the shaft is subject to the greatest uniform strain, simply, because the wheels have a higher velocity on these occasions than when the vessel is exposed to rough weather, which quickly brings it down, and also the velocity of every part of the engines. When this takes

place to the extent of reducing the speed of the paddle-wheels from 20 revolutions to 10, then the power is no more 200 horses power, for the same rule that made it such, reduces it to 100 horses power. Here we have a striking proof of the difference between steam, and animals, as *prime movers*. When a horse sets his nose to a hill, he slackens his pace, exerts a greater quantity of power, and surmounts the difficulty. But these are the works of God,—steam mechanically applied, that of man.

Rough weather tries the machinery of a steam-vessel in a different way from that which proceeds from steady pressure. Then comes the dash of the sea's tempestuous waves against the paddle-wheels, until the whole ship reels again. Effects like these, or any other having a direct tendency to arrest or accelerate the motion of the paddle-wheels by violent shocks, furnish a good reason for the internal machinery being so strong; and until these evils are made harmless, it would be a dangerous experiment to reduce the strength of the machinery from the proportions given to it by some of our first-rate makers.

To make these evils harmless brings me to that part of my subject, which is explained by the accompanying figures.

Fig. 1 is a plan, and fig. 2 an elevation. *a* represents the end of the paddle-shaft, upon which the friction-drum *b b* is made fast; *c c* is an iron hoop, which is turned and fitted to the drum *b b*, and *d* is an eye formed on the hoop to receive the crank-pin of the engine, which turns it. There are two, one to each paddle-wheel, as would be the case with cranks employed. If the hoops *c c* are not tight upon their respective drums, it is clear the engine would drive them round without moving the paddle-wheels; and, on the contrary, were the engines at rest, and the vessel in motion, the paddle-wheels would revolve without disturbing the engines. The paddle-wheels are thrown into geer by applying a lever to the box *e*, and turning it round. It has two female screws, the one right and the other left, at each end of it, and the bolts *g g* have threads to fit them. When the box *e* is turned round, it screws up the two bolts *g g*, through which the steel bars *f f* pass, and tightens the hoop *c c* elastically upon the friction-drum, the steel bars yielding sufficiently to produce that effect. To overcome this quantity of elastic friction is the greatest strain the engines can at any time be exposed to; so that, were the wheels struck by a heavy sea, to accelerate their motion beyond the regular speed of the engines, the friction would be overcome, and the drum *b b* would slip round faster than the driving hoop. Again, if the sea strikes the wheels to retard their motion, and with sufficient violence to overcome the friction, then the hoop would slip before the drum; and in either case the blow is confined to the extent of the friction upon the drum *b b*, however great may be the violence which produces it.

The wheels, too, will be much relieved by the liberty of moving on trying occasions like these, independently of the engines; and the elasticity of the steel bars *f f*, upon which the friction depends that drives them, will prevent any liability of slackness, otherwise unavoidable, from the frequent rubbing of the two surfaces *b b* and *c c*.

In conclusion, to the mere principle of driving paddle-wheels by friction I lay no claim, but the method here shown and described is my own; and I hope the importance of the subject may attract your attention, and, for the benefit of the Company's interests, you may be induced to give the plan a fair trial.

I have the honour to be,
Gentlemen,
Your very humble servant,
JAMES WHITE.

October 4, 1842.
Lambeth, near Haddington, N. B.

## MR. JOSIAH PARKES, AND MR. LUCY'S ISO-DYNAMETER.

Sir,—Your correspondent, "A Looker-on," may find a very explicit description of the apparatus adopted by Mr. Lucy as a substitute for his fly-wheel, with a figure, in Mr. Scott Russell's Encyclopædia Britannica Treatise on the Steam-engine, 8vo edition, page 184, *et seq*. Perhaps a few remarks upon this machine may not be uninteresting to your readers generally.

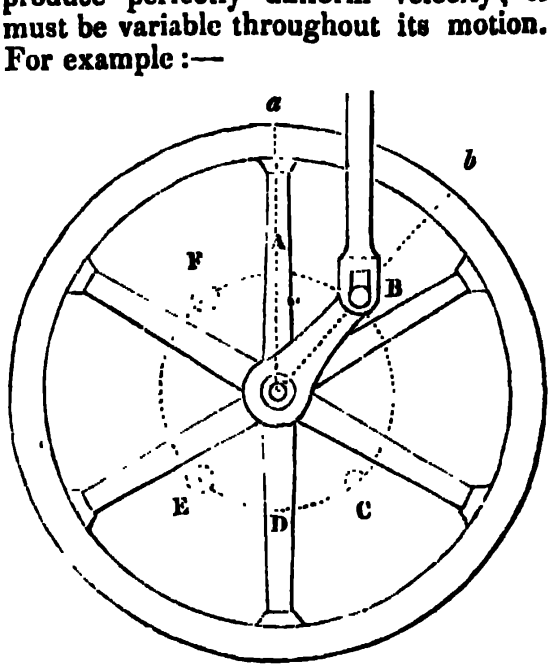
There are two advantages ascribed to this apparatus, of a distinct and separate nature: the first, that, *by its substitution for the fly-wheel*, the motion of the engine has been rendered more equable; the second, asserted only by Mr. Parkes,

that it has increased the power of the engine 11 per cent.

Now we all know, Mr. Editor, that facts are, to use a homely phrase, stubborn things; and to deny the existence of a fact vouched for by parties whose veracity can be trusted, is unreasonable, and can only be the last resort of a worsted opponent's bigotry. But we also know, by every-day experience, that parties are often apt to expect us not only to believe their facts, but also to adopt, as of equal authority, the *inferences they deduce from them*, which are in a very different category. A dozen people may found as many diverse opinions upon the same data, according to their different modes of reasoning; and indeed it has become almost proverbial, that facts may be made to prove any thing: there scarcely ever was an hypothesis or invention ushered into existence, however absurd or useless, which had not a multitude of facts brought forward to support it; the parties all the while forgetting, that, while the public might admit the fact, they might demur altogether to the inference drawn from it. Whenever, therefore, we find parties ascribing, dogmatically, certain effects to certain causes, we are bound to treat them, not as historians, but as reasoners, and to demand that they show us a legitimate and logical connexion between the inference they deduce and the fact from which they deduce it. Without this, the fact itself, however authentic, proves nothing at all.

So with Mr. Lucy's apparatus; while it would be both unjust and uncivil to accuse our informants of having propagated falsehoods, when they have asserted that Mr. Lucy formerly broke and destroyed his wheels so fast, that, "in 1838, the ruins were strewed about the yard"—that formerly he made bad flour, and now he "commands the market"—that formerly he drove nine pairs of stones, and now drives ten—yet we may be allowed to call for something like proof that these effects are legitimately attributable to the substitution of the *Iso-dynameter* for the 24-ton fly-wheel, before we are expected to adopt as true such an hypothesis. We will, with all due deference, bring forward some arguments *contra*.

First, as to the alleged removal of the irregularity of motion. It must be admitted at once, that it is impossible a fly-wheel, of however great weight, could produce perfectly uniform velocity; it must be variable throughout its motion. For example:—




While the crank is moving from F to B, or from C to E, the velocity will decrease; from B to C, or from E to F, it will increase; at C and F will be its maxima, at B and E its minima. But we are enabled, by a simple application of the laws of dynamics, to ascertain the extent of the irregularity, thus: let $x$ = the space, as $a\,b$, moved through by the fly-wheel rim, while the crank is describing any angle, A O B, which make $= \phi$. If $p$ = the uniform effective pressure on the piston, the effect of this to turn the crank is $= p \sin. \phi$, (disregarding the obliquity of the connecting-rod,) and the effect on the fly-wheel rim $= \frac{p\,c}{f} \sin. \phi$, where $c$ = radius of crank and $f$ that of the fly. Then the *resistance* to the motion of the fly-wheel rim caused by the work $= 2\frac{p\,c}{f\pi}$; and $m$ being the mass of the rim, the equation of motion is

$$m\frac{d^2 x}{d t^2} = \frac{p\,c}{f}\left(\sin. \phi - \frac{2}{\pi}\right) \text{or, since } \phi = \frac{x}{f},$$

$$m\left(\frac{d x}{d t}\right)^2 = 2\frac{p\,c}{f}\int\left(\sin. \frac{x}{f}\,d x - \frac{2}{\pi}\,d x.\right)$$

Let V = the mean velocity when the crank is at A, and $v$ = the velocity at any other point of the revolution; then, by integrating and correcting the integral,

$$v^2 = V^2 + \frac{2\,p\,c}{m}\left(\text{vers. } \phi - \frac{2\,\phi}{\pi}\right)$$

If $p$ and $m$ be expressed in the same unit of *weight*, $gp$ must be substituted for $p$ in the equation, $g$ being the measure of gravity.

To apply this to Mr. Lucy's engine, (40 horses power,) we may suppose $V = 20$ feet per second, $p = 6{,}000$ lbs., $c = 3$ feet, $m = 53{,}760$ lbs. The *maximum* value of $v$ is then found to be

$= 20{,}112$ feet per second,

and the *minimum* value

$= 19{,}887$ ,,

so that the greatest and least velocities during the stroke have a ratio to each other of about 91 to 90; or the greatest difference from the mean is about $\frac{1}{180}$th of the whole—an amount of irregularity which I think we might safely defy either Mr. Parkes's eyesight, or Mr. Lucy's flour, to discover.

This is the extent of the evil caused by the fly-wheel; let us now inquire how it is removed. Is it by the substitution of an apparatus which, according to the import of its pompous name, "*Iso*-dynameter," exercises, like water power, a perfectly uniform and equable force on the crank-shaft? Far from it—it does not even profess any thing of the kind. It might easily be shown that the uniformity of force must, in the pneumatic apparatus, be interfered with by many extraneous causes, but this is unnecessary; we will take Mr. Scott Russell's own testimony, as he is very competent authority. His words are, "The deviation from the mean pressure is not, therefore, greater than *twenty per cent.!* and the equalization produced by Mr. Buckle's pneumatic equalizer is as efficient as a pair of engines, and much less complicated and expensive." We need not stop to inquire the effect of this 20 per cent. variation on the velocity, where there is no fly-wheel; but I would ask, is it not ridiculous to expect us to believe that the removal of one regulator, which varies the velocity only $\frac{1}{2}$ per cent., and the substitution of another, which varies the force 20 per cent., should make such marvellous changes for the better? Mr. Parkes is not, unfortunately for him, much in the habit of using mathematical analysis; but it is to be regretted that Mr. Scott Russell, who is one of our most able investigators, did not examine the bearings of the statement he was publishing a little more closely.

The other great advantage stated to arise from the iso-dynameter is, the gain of 11 per cent. on the power of the engine. It must, however, be noticed, that Mr. Parkes has the glory of this *inference from fact* all to himself; Mr. Scott Russell evidently gives no sanction to such a notion; he says, "It was found that the change enabled them to give all the grindstones a greater velocity than formerly, so that the quantity ground was greater, in the proportion of 56 to 52." This is a very different thing from Mr. Parkes's assertion; the former merely implies a different and more advantageous mode of applying the power exerted, the latter asserts an absolute gain of power.

Now, if any such gain is caused by the substitution of the pneumatic apparatus for the fly-wheel, it must be either, 1. Because the action of the fly-wheel, *per se*, causes a *loss* of power; or, 2. Because the action of the iso-dynameter, *per se*, causes a *gain* of power; or, 3. Because the difference between the frictions of the two methods is in favour of the latter to the amount stated.

In these days, when the schoolmaster is abroad, and is teaching the principles of mechanics among other things, we can hardly suppose that Mr. Parkes, although he has some extraordinary mechanical notions (as vide his speech on Professor Moseley's Indicator, *passim*,) would attempt to persuade us that the gain was referable to either the first or the second of these, for this would be equivalent to contending, that if a hundred apples were sent home from Covent Garden Market, in a peculiarly-shaped basket, they would become one hundred and eleven when they arrived at the end of their journey. The third, then, only remains; and a very little consideration will show that the friction of the equalizing machine is the same in many of its principal items as that of an engine of 20 horses power; and it is for Mr. Parkes to prove his case by showing, if he can, that this, *plus* the friction of the two spur wheels, is *less by 4 or 5 horses power* than that which was before caused by the weight of the fly-wheel.

It frequently happens that the prospects of an invention, which, confined within its proper and natural bounds, might be useful and successful, are seriously injured by the extravagant and unfounded pretensions made for it (frequently *to order*) by its *soi-disant* friends.

The present seems a case in point; if the $\frac{1}{16}$th irregularity caused by the fly-wheel *is* a perceptible disadvantage, the use of such a machine as Mr. Lucy's, *in conjunction with a fly*, as recommended by Mr. Scott Russell, would, probably, not indeed remove it altogether, but considerably lessen it; and if the extra friction were no object, the invention might in such instances stand a chance of being used: but when it pretends to *supersede* the fly-wheel, to remove entirely the little irregularity it occasions, and to give by some magical process or other an extra 11 per cent. power to the engine, the mechanical public will be very apt to class it with the disc engine, the locomotive momentum, the Cornish percussion, the Boccius gas phenomenon, and other new lights, which Mr. Parkes has of late been so industriously exhibiting to the world.

I am, your obedient servant,

*π*.

London, October, 1842.

## READMAN'S BAROMETER.

Sir,—Reading in your last Monthly Part of the *Mechanics' Magazine* a description of a barometer lately patented by Mr. Readman, may I beg you to insert the inclosed letter, which was written to the editor of the *Meteorological Journal* in February, and published in the following *Quarterly Journal* of April, 1842? This document will prove how much of the originality of the invention is due to me, and how much may be the probable value of Mr. Readman's patent.

"To the Editor of the *Meteorological Journal.*

"Dear Sir,

"I beg to submit the following suggestions on the construction of barometers to the consideration of the readers of your interesting Journal.

"Let the upper four or five inches of the barometer tube be so selected, or otherwise prepared, that each inch of the length shall contain a similar weight of mercury; and let the bore be about half an inch in diameter.

"Let this tube be immovably attached to a wooden frame provided with a scale and vernier, capable of indicating differences amounting to the one-thousandth part of an inch.

"Let the mercury cistern be of iron, having its interior truly turned or bored of such diameter, that its capacity, with relation to that of the upper portion of the *tube*, shall be, when taken inch for inch in length, say, as 10 to 1.

Under these conditions it is obvious, that, if the mercury within the *tube* should fall one inch, that in the *cistern* will rise one-tenth of an inch. But no true indication of the absolute effect dependent upon any atmospheric change can be deduced therefrom without calculation, because the surface of the mercury within the tube, and of that within the cistern, will have approached each other at least the one-tenth of an inch too much; and, moreover, the mercury within the tube will have been prevented from falling so low as it otherwise would have fallen, by reason of the counterbalancing effect due to the improperly raised level of the mercury in the cistern.

"Suppose, however, the cistern to be *suspended* from the frame of the tube by two spiral springs, (similar to those of Salter's Balances,) so adjusted that the increased weight of the fall of one inch of mercury from within the tube shall depress the cistern, with its contents, just one-tenth of an inch. Then the due compensation will be effected; and this compensation will hold good throughout the entire range of the graduated scale.

"As an improvement upon the graduated scale and vernier in common use, I recommend a triangular bar of gun-metal, about six inches long, and graduated into inches and tenths, each tenth of an inch being again subdivided into five parts. Upon this bar, (which may have its three sides each half an inch wide,) a brass vernier, having a 'clip" and tangent-screw attached to it, should be made to slide accurately. The vernier should carry a steel index-point; and the divided portion should contain 20 divisions in the space of 19 subdivisions on the bar.

"The bar should be supported in its proper situation by means of two small projecting brass pillars, fixed perpendicularly upon the wooden frame at an appropriate height, and at a distance of about seven inches apart. Each of these pillars should be perforated at right angles to its axis, for the reception of a pointed steel screw with a brass milled head. The precise height of the graduated bar is to be adjusted by means of these screws, whose points should fit into centre punch cavities in the extremities of the bar.

"By these arrangements, (simple in reality, though tedious to describe,) a very accurate reading may be obtained; and the graduated bar, (which revolves perpendicularly, like a crane, around its centres, when the barometer is held vertically,) together

with its vernier, can be readily removed, (by releasing the screw of the *upper pillar*,) and applied to any number of barometers similarly constructed, without affecting the original adjustments of any of them, provided the screws in the *lower pillars* be not disturbed."

"CHARLES THORNTON COATHUPE."

"Wraxall, near Bristol, Feb. 18, 1842."

This is the second time that I have freely given to the public inventions that have been subsequently considered worthy of being patented by others. I do not mean to imply that the parties were at all aware of the previous publication of their own ideas, which were, doubtless, as original with them as they were with myself; but I see no harm in claiming one's own, and in presenting what one can afford for the free use of all.

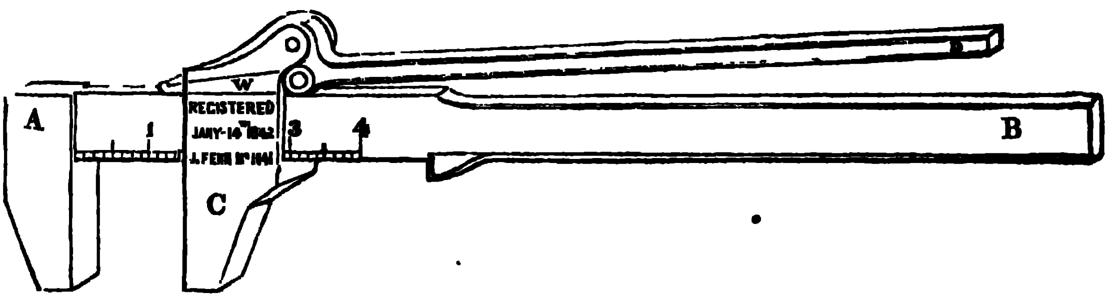
I am yours very truly,

CHARLES THORNTON COATHUPE.

Wraxall, near Bristol, Oct. 13, 1842.

[Mr. Readman's patent was granted in February last; and *previous to that date* we perused a description of his barometer in manuscript, which differed in no material respect from the specification which he subsequently enrolled. Our esteemed correspondent, Mr. Coathupe, will be quite satisfied, therefore, that Mr. Readman could not have derived his ideas on the subject from the paper by Mr. C. in the *Meteorological Journal*, which we now republish, since that paper did not make its appearance *till April*—about two months afterwards. Neither is the legality of Mr. Readman's patent at all affected by the circumstance of Mr. Coathupe's having published a description of the patented invention prior to the enrolment of Mr. Readman's specification; for, in law, an invention is held to be of the date of the patent, and not of the specification.—Ed. M. M.]

## FENN'S COACH WRENCH.




Sir,—Permit me to call the attention of your readers to the novel and effective arrangement of the coach-wrench, illustrated by the accompanying figure, and recently brought out by Mr. Fenn of Newgate-street. I think most artisans will acknowledge its merits on inspection of the design, but having had it in actual use for some time, I can speak in its favour with the additional confidence gained by experience.

It is, as will be seen by the drawing, an ingenious combination of the lever and wedge, so arranged as to afford the utmost facility of movement, combined with the power of resisting the heaviest strain which the strength of the materials is capable of bearing; these are the essential qualities of a wrench intended to span different sized nuts, bars, or bolts, and I have no hesitation in saying, that the tool under consideration possesses them in a higher degree than any other I have met with of its class.

*Description of the Engraving.*

The cheek A is forged in one piece, with the bar A B, which is cut like a float file on its under side. The traversing cheek C, is slotted so as to travel on the square part of the bar, and may be securely fixed to any part of it by pressing the small lever D towards the other portion of the bar, and thereby forcing the wedge W into its seat; this, it should be understood, is done by the act of grasping both parts of the handle in one hand when about to use the tool.

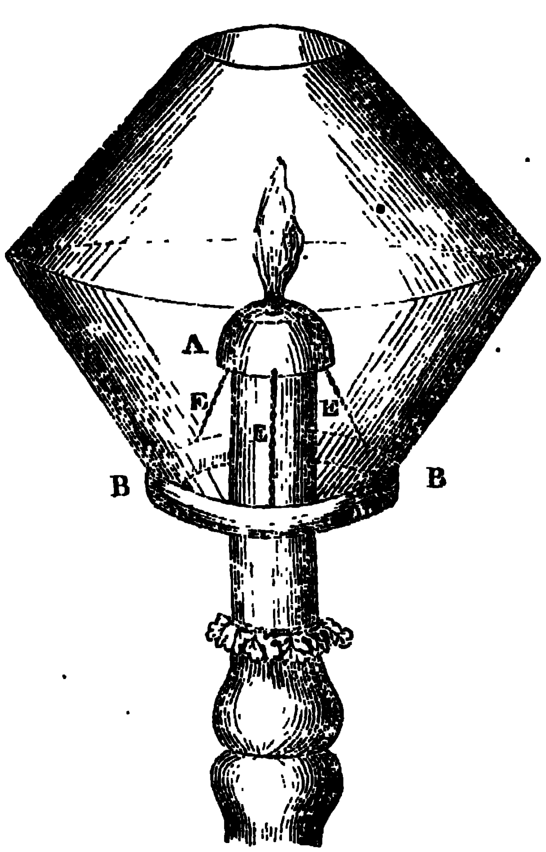
I have no hesitation in asking the favour of a place for this description in your Magazine, because its pages contain ample proof of your readiness to give publicity to useful contrivances.

I remain, Sir, yours very respectfully,

T. B. J.

Pimlico, October 10, 1842.

SELF-ACTING CANDLE SHADE.




Sir,—Having derived great benefit from the use of a shade over the common candle, of a new construction, you would be doing a service probably by making it known through the medium of the *Mechanics' Magazine* to that portion of your readers who may have occasion to read or write much by candle-light. For the method of suspending the shade I am indebted to the invention of the "Candle-Guard" of Mr. David Thomas, 18, Goswell-road, for the prevention of guttering in candles, for which he received the Silver Isis Medal from the Society of Arts.

A is a cone of glass with a hole for the wick to obtrude through, which, by projecting over the top of the candle, forms a cup to retain the melted grease, and prevents it from guttering down the side. This glass cone is kept in place by a ring of glass or metal B B, suspended by three chains or cords E E E, to the cone, which, as the candle burns, causes the cone of glass to descend evenly on it.

Observing the great use of this in currents of air, I made one, but instead of the solid ring of metal, or glass, I had a hollow gutter with the chains attached to the inside edge. I then formed a light wire frame, and covered it with thin paper, by which means the light is beautifully radiated and softened to the eyes. If the metallic wick candles are used, there will be no necessity for the removal of the shade from the gutter or rest for snuffing. A slight-tinted paper of a lilac colour has a very beautiful effect; the paper should be previously moistened with a solution of borax, as it will prevent its taking fire.

As this is the only method by which a self-acting shade can be attached to candles used in common candle-sticks, it is likely to be serviceable; or for workshops, I would greatly recommend the use of Mr. Thomas's Candle Guards as saving a deal of otherwise wasted tallow.

I remain, yours obediently,

CHARLES CROYDON.

P. S. In the prefixed figure the shade is supposed to be transparent for the sake of better showing the interior.

Devonport, October 12, 1842.

## ZANDER'S EXPANSION AND CONDENSING SYSTEMS.

Sir,—I beg to thank you most sincerely for the favourable account of my steam-engine improvements given in the last number of your valuable Journal; and also for the insertion of the principal items in my Comparative Table of the Dimensions and Performances of the *Era* steamer and her six competitors. But, as I wish the principles on which this Table has been calculated should be well understood, I have to request you will do me the additional favour to insert a few words in explanation of the same.

The elements which we have to take into consideration, when calculating the motion of a vessel through the water, are:—

1. The friction of the exterior surface of the vessel immersed in the water.

2. The resistance of the vertical midship sectional area in the water.

3. The angle of incidence the vessel has at head and stern.

But, as the seven vessels included in the Comparative Table are nearly all alike in form at head and stern, we need only take into account the first and second elements.

1. The way in which the friction is calculated is this:—The resistance caused by the friction which the surfaces of dis-

[See p. 394.

SUPPLEMENT TO THE COMPARATIVE TABLE OF THE DIMENSIONS AND PERFORMANCES OF SEVEN STEAM-BOATS PLYING ABOVE LONDON BRIDGE.

| | Era. | Thunder and Lightning. | Minerva. | Vivid. | Eclipse. | Thistle. | Dart. |
|---|---|---|---|---|---|---|---|
| Dynamical number, or work done by each vessel ........ | 20123·25 | 19081 | 16813·569 | 20940·527 | 19862·334 | 18628·86 | 13663·33 |
| Each square foot of the dynamical resisting surface of the vessel requires, in order to propel it through the water, the following number of cubic feet of steam, at 25 lbs. absolute pressure, to be consumed in one minute ...... | 5·013 | 16·459 | 10·327 | 26·623 | 21·820 | 23·264 | 27·670 |
| Ditto, ditto, lbs. of coal to be consumed in 14 hours, including stoppages .................................... | 35·900 | 111·[illegible] | 80·9 | 119·2 | 119·2 | 123·1 | 183·3 |
| Ditto, ditto, square feet surface of all the paddles immersed in the water .................................. | 0·943 | 1·310 | 0·903 | 0·955 | 0·963 | 0·831 | 1·094 |
| Ditto, ditto, number of horses power .................. | 0·906 | 1·257 | 1·084 | 1·105 | 0·990 | 1·056 | 1·125 |
| Each square foot of the actual midship sectional area of the vessel immersed requires, in order to propel it through the water, the following number of cubic feet of steam, at 25 lbs. absolute pressure, to be consumed in one minute.. | 5·415 | 17·506 | 11·104 | 28·345 | 23·204 | 24·607 | 29·340 |
| Ditto, ditto, square feet surface of all the paddles immersed | 1·006 | 1·393 | 0·971 | 1·017 | 1·024 | 0·879 | 1·159 |
| Ditto, ditto, number of horses power .................. | 0·966 | 1·33 | 1·16 | 1·17 | 1·05 | 1·11 | 1·19 |
| Square feet of dynamical resisting surface of the vessel propelled by each square foot of paddle-boards immersed .. | 1·059 | 0·763 | 1·106 | 1·046 | 1·037 | 1·202 | 0·914 |
| Square feet of surface of all the paddles required to be immersed for each horse power ...................... | 1·04 | 1·04 | 0·83 | 0·86 | 0·97 | 0·78 | 0·97 |
| Square feet of the dynamical resisting surface of the vessel per horse power ................................ | 1·103 | 0·795 | 0·922 | 0·904 | 1·009 | 0·946 | 0·882 |
| Square feet of the actual midship sectional area of the vessel immersed in the water, per horse power ............. | 1·035 | 0·747 | 0·857 | 0·849 | 0·948 | 0·894 | 0·838 |

placement (exterior surface of the vessel immersed in the water) make in the water is compared with the resistance which the same area would experience if moved perpendicularly in the water, at the same depth for each vessel.

2. Dynamical resisting surface, is composed of the midship sectional area and friction of exterior surface of the vessel, being the actual measurement of resistance (reaction from the water) for the vessel, and power of the steam-engine.

When, therefore, the dynamical resisting surface is multiplied by the cube of velocity, in each case, the product gives the relative dynamical resistance of the vessel, or, what is the same thing, the comparative force exerted by the steam-engines in order to propel the vessels through the water. The dynamical numbers for each of the vessels are then as stated in the accompanying Supplementary Table.

When some farther improvements are perfected which I have in progress, I entertain a confident expectation of being able to carry the advantages of the expansion system still farther than have been done in the *Era*—to the extent, in all probability, of one-fourth more of actual duty performed.

I remain, Sir, your obedient servant,

H. ZANDER.

Chelsea, October 19, 1842.

## THE CHEMICAL PRINCIPLES OF COMBUSTION ASSERTED AGAINST THE MECHANICAL ABSURDITIES OF MR. SAMUEL HALL. BY C. W. WILLIAMS, ESQ.

Sir,—In a recent communication of Mr. S. Hall, to the "Mining Journal," he seeks to disparage those chemical principles which I have taken as my guide in the admission of air to furnaces, and on which I rely for producing a more perfect combustion of the gaseous matter from coal. These principles, although emanating directly from the writings of Davy and Dalton, Mr. Hall, nevertheless, has characterized as "Fudge." Involving, however, as they do, considerations of public interest, it is worth inquiring what those principles are? what support they have from high chemical authority? and what are their direct bearings on the subject of combustion, practically considered?

Again, as Mr. Hall has charged me with an "overweening vanity" in this matter, I am desirous of submitting to the public the grounds on which my pretensions, as a patentee, are based. This is done in a few words. In my inquiry respecting the combustion of the gaseous matter from coal, I had to compare the effects produced by the coal gas when issuing from a single *large* orifice, or when it issued from the fourteen orifices of the argand burner. I perceived that the greater perfection of combustion which the argand lamp exhibited was directly occasioned by the more numerous, and therefore enlarged surfaces for contact, which the jets presented; "in the same way," as Dr. Brett observes, "as the surface of any given volume of water is increased by causing it to pass, in thin streams, through numerous apertures."

"My first view, therefore, towards effecting a more perfect combustion of the gas generated in *furnaces* was, to imitate the principle of the argand burner, namely, the bringing the combustible gas in *the form of jets* to the atmospheric air. I was soon, however, compelled to reject this mode of proceeding, as I found, according to the reasoning and practice of Sir H. Davy, (and which led to the discovery of his safety-lamp,) that the heated gases were soon brought below the temperature of ignition, by the cooling effect of passing through small apertures; and that their combustion was thereby prevented, as when a wire gauze is held over the flame of ignited gas.

Under these circumstances, I almost despaired of carrying the principle of the argand burner into the furnace; chemistry, however, came to my aid, and enabled me to effect my purpose. Observing the conditions under which chemical action is induced, and combustion effected, I concluded on reducing to practice the principle which chemistry alone could have taught, namely, that combustion would be equally effective and energetic, whether the combustible be brought by jets to the supporter, or the supporter to the combustible. Following out this principle, it was to be expected that the effect would be the same, if, instead of bringing the furnace gases in jets to the air, I reversed the process, and brought the air in jets to those gases. The first attempt proved that the principle was equally applicable on the large scale of the furnace, as the small scale of the laboratory lamp, and my success was complete. This, then, became the subject of my patent. After many experiments, I found that the sole conditions of success were, 1. That the combustible gas should be brought to the high temperature required for chemical action and union with oxygen; and, 2. That either one or the other—the gas or the air—be introduced in *the way of jets;* this principle of jets being the only means of effecting that sudden and surface contact between the gas and the air,

which is the *sine qua non* of their union and combustion, where *time* cannot be allowed for the more deliberate and true Daltonian diffusion.

In practice, then, and for the first time, the fact was illustrated *on the large scale,* that "*combustible*" and "*supporter of combustion*" were convertible terms; and that jets of air introduced to the gas, or jets of gas to the air, had equally the effect and appearance of jets of *flame*.

Here, then, is the extent of my claim to a patent. To this Dr. Kane refers, when he pays me the high compliment of saying, "the value of this, although obscurely felt by others, from the imperfection of the older methods, has been certainly first placed in its important and just aspect by your illustrations." Here is the practical application of a well-known chemical principle in the combustion of gaseous bodies. It is not the introducing the air in this place, or that place, (and in what place has not the air been introduced by some inventor or other?) but *the mode* of introducing it; and they who dispute my principle, or the value of my mode, must be prepared to say that there is no difference, in effect, between the argand burner and the single large jet. Here, then, is my claim on the score of "invention," as it is termed in patent law. To this alone does my "overweening vanity" extend.

In the course of my experiments I became convinced of the all-commanding importance of raising the temperature of the gases in the furnace before bringing them into contact with the air; and that, provided these conditions of *numerous jets* on the one hand, and *high temperature* on the other, were satisfied, it was immaterial, in practice, how large the scale of operations might be —in what place the jets were introduced; whether they began at the bridge, or at intervals of ten, or even twenty feet distant. The principle on which I relied is, however, so clearly enunciated in the following extracts from the opinions of Professor Brande and others, that I here quote them, as the best reply to Mr. Hall's "Fudge."

Professor Brande observes—"you admit a number of jets of air into a heated inflammable atmosphere, and so attain its combustion in such a way as to produce a great increase of heat." Again—"In this way each jet of air which you admit becomes, as it were, the source or centre of a separate flame; and the effect is exactly that of so many jets of inflammable or coal gas ignited in the air: only, in your furnace, you *invert the ordinary state of things*, and use a jet of air thrown into an atmosphere of inflammable gas; thus making an experiment upon a large and practical scale, which I have often made on a small and theoretical one, in illustration of the inaccuracy of the common terms of *combustible*, and *supporter of combustion*, as ordinarily applied." Mr. Brande then adds—"I have no hesitation in saying, that the views promulgated in your essay are substantially founded upon just and scientific principles." After such a testimonial, may I not almost be censured for noticing such cavillers as Mr. Hall, who can look at these views and principles as "Fudge?" Respect for myself, however, and respect for the public, who have a right to examine the claims of every man who seeks to have his opinion received, has alone induced me to make this communication.

I might here enumerate many such testimonials from men of high standing, but will content myself with the following extracts from deliberately-written and elaborate examinations, both of my treatise, and the principles on which my mode of admitting air is based. Dr. Ure observes—"In case of great steam-boiler furnaces, for which your patent is especially intended, your plan of distributing atmospheric air in a regulated quantity, by *numerous jets*, through the body of gasiform matter, is peculiarly happy; and must enable you to extract the whole heat which the combustible is capable of affording." Dr. Brett, of the Royal Institution, Liverpool, says—"By causing the atmospheric air to be drawn *by jets* among the inflammable gases, you employ, as it appears to me, the only means practicable, in operations on a large scale, of causing a sufficient mechanical admixture between the air and the gases to be burnt. By such means you considerably *extend the surface* of any given bulk of atmospheric air admitted, in the same way as the surface of any given volume of water is increased by causing it to pass in thin streams through a vessel containing numerous apertures." Again, 'the old mode of combustion in furnaces is manifestly incompetent to effect this perfect combustion, which is only to be obtained, in my opinion, by a plan based upon such principles as you have advocated."

Dr. Kane observes, "The introduction of air at the bridge and along the flame bed, to supply the quantity of oxygen necessary for the combustion of the volatile products of the coal—the diffusion of this air, *secured by its issuing from a great number of small jets*, and the consequent full combustion of the gaseous fuel, are elements of real economy and success in practice. The value of this, although obscurely felt by others, from the imperfection of the older methods, *has*

*been certainly first placed in its important and just aspect by your illustrations.*"

These, I repeat, are the principles on which my claim to the attention of practical or scientific men is based—these are the bounds by which my "overweening vanity" is circumscribed.

But, I ask Mr. Hall, will *he* explain the principles (if he have any) on which he expects to produce a more perfect combustion than any other patentee? for surely he has no right, on his mere *ipse dixit*, to expect that all the world will yield to his mere assertion, and particularly, on so difficult a subject as combustion.

Now, to bring Mr. Hall, and his invention to a practical test, I ask him to satisfy the public on the following points:—1st, On what principles does he expect a more perfect combustion in steam boiler furnaces, by the use of *hot*, rather than *cold* air, when unaccompanied by the blast; for such is not advocated by any chemical authority? 2nd, On what principle does he rely, when he introduces this hot air at the *front* end of the furnace and near the door, rather than at the back end, as done by Mr. Coad? 3rd, On what principle does he rely for increasing the quantity of oxygen in a furnace, by heating the air which is to supply such oxygen—seeing that every well-informed chemist tells us, that the hotter the air is made, the less oxygen will be introduced? 4th, On what principle does he rely for preferring to burn *the smoke*, rather than *the gas*, from which the smoke is generated, by some imperfection in the process? To common minds, it appears a more common sense proceeding, to burn the gas, in the first instance, by a perfect process, (as we do in the Argand burner,) rather than adopting the round-about measure of, first, making the smoke, and then endeavouring to burn it.

Until these questions are answered, clearly and explicitly, (and which, *I guess*, he will be rather slow in doing,) Mr. Hall is not justified in expecting that his mere *dictum* is to pass for authority; or in charging the principles of others as "fudge."

I am, Sir, yours, &c.

C. W. WILLIAMS.

*Liverpool, October 17, 1842.*

## PURE WATER v. IMPURE CISTERNS.

Sir,—In bringing this discussion to a close, I beg to offer a few additional remarks, and, in the first place, to our "old friend Cole," who, it seems, must needs have a *brush* with me, and brings forward such *sweeping* arguments, that the Atlantic itself might well recoil from his sturdy *besom*. Mr. Cole states (as a *fact*) at page 333, that the water as it comes from the main is so thick as to be unfit to drink, or to use in the preparation of food"—and thence he argues the *inutility* of occasionally cleansing our cisterns. If his statement had any foundation in truth, it would rather go to enforce the necessity of adopting this precaution. I will, in return for Mr. Cole's, also mention a fact, which is, that where the daily supply of water is drawn direct from the main, without the intervention of cisternage, better and purer water is generally obtained than where filtration by deposition within a cistern takes place—neutralized, as it too often is, by admixture with a mass of accumulated impurities. The only exception to this rule occurs during the prevalence of heavy rains and floods.

The improvement in cisterns suggested by Mr. Cole at the close of his letter is too good to give away—it must be patented.

My doughty antagonist "B.," having closed his case, a few words in reply will dispose of him; for I think it can hardly have escaped the notice of any attentive reader, that "B." has most studiously avoided the only point upon which he professed to join issue with me—viz., the state of the water *as supplied* by the London Companies! The whole of his last lost labour was to have proved two things—Firstly, "that impure water was injurious to health and to life;" a proposition which, I apprehend, no sensible person would ever attempt to dispute. I certainly never did; on the contrary, in my opening paper I gave a striking proof of the fact from my own personal observation. This proposition I hold to be incontrovertible, and therefore think the evidence adduced in support of it altogether superfluous.

The second proposition was, "that the water, particularly *as supplied* by the London Companies, is impure, and a primary cause of the augmenting mortality of the metropolis." To support this proposition, extracts are brought forward, from the evidence of medical men and others; but it will be seen that they are all out of court—not one single evidence relating to the fact sought to be established. Not one of these parties speaks to the quality of the water *as supplied!* The greater portion of the remarks refer generally to the water *as used*—*i. e.*, as drawn from filthy cisterns; and *not as supplied*. Other extracts relate to water *taken from the Thames* close to the mouth of common sewers, and in some cases (to ensure the desired results) from the sewers themselves. Sir John Hall is made to illustrate the quality of the water *as supplied*, by

speaking to that of the stagnant water in the St. Katharine's Docks!" Oh fie! Mr. "B.," call you this "honest—ay, honest?"

That the water, *as supplied*, is impure *to the extent assumed* (the injury of health and cause of death) I have already given a denial; its impurity, in a qualified sense, I willingly admit. To the latter limb of the proposition I merely reply, that, as no "augmenting mortality of the metropolis" exists, the attempt to ascribe an effect, which has no existence, to any particular cause, is truly absurd. The health of the metropolis, like that of all other towns, fluctuates with the seasons, and therefore must be attributed to *general* and not to *local* causes. The insinuation may be ingenious, but it is assuredly unjust.

The effect produced upon the milliners' girls, and attributed to their drinking *impure water*,* might be referred solely to the filthiness of the *water butt*—or with much greater propriety, to the sedentary nature of their employment, and the impure and unwholesome atmosphere in which the "female slaves of England" usually labour; the effects of which, in producing "pallid faces" as well as aching heads and hearts, are, alas! too well known.

Going "out of town for a few days," affording, as it does, relaxation from mental and bodily labour, change of air and scene, would produce a beneficial effect upon persons engaged in much less unwholesome employments than that of "milliners' girls"—leaving change of water (which is *not* always for the *best*) entirely out of the question.

But a drowning man will catch at a straw, and "B." must have been sadly at a loss for *proofs* when such lame cases as these are brought forward. They are quite out of place in a practical and scientific discussion; as are likewise the quoted expressions of a noble lord, who is represented to have said, "that he would not take a bath in the water as supplied to him, much less drink it." The noble lord's expression is *no proof whatever*, either of the goodness or the badness of the water; *if true*, it is merely a proof of his lordship's effeminate fastidiousness, and I pity him. If "Alexander the Great" prefers a bath of double distilled lavender water, and his means can compass such a luxury, in the name of all that's delightful let him have it, and welcome—"every one to his liking."

And yet, I fancy ere this noble lord gained any laurels in America—or ever smoked his first puff with brother Jonathan, he did actually gulp down some of this much-abused "*compound*;" for I believe the ship that carried him out was not provided with a store of *Stuckeyfied water** for his lordship's *private use*. As for "B.'s" "raw head and bloody bones" *stories* about "poison water," he must tell them to the marines, the sailors won't believe him; and who, after all, are better judges of fresh water than the sailors? Ask Jack where he gets the best water, and where he takes care to ship the largest quantity that he can carry—he will tell you, "in the Thames!"

Numerous as have been my contributions to your pages, I remember none that has been received as was my first on this subject: I have received numberless thanks for calling the attention of parties to a matter which had so entirely escaped their notice, and I know that there has been more "cistern cleaning" going on during the last month, than London ever saw in twelve months before. What may be the ultimate result of this discussion I know not, but its present effect has been (as intended) extremely beneficial, and in taking leave of the subject, I beg to submit the following practical deductions, leaving each person to apply them as seems best for his particular object.

1. The water stock of the Londoners is impure.

2. The sources of impurity are two-fold, viz., Firstly, The impurities supplied with the water by the water companies. Secondly, The impurities which enter the cistern and become mixed with the former.

3. The remedy for the first of these impurities, rests entirely with the water companies.

4. The second source of impurity is within the power of every housekeeper materially to diminish, in two ways:—Firstly, By closing up all those apertures through which a great variety of animal and vegetable matters now find ready access to our cisterns. Secondly, By occasionally (say two or three times a year†) clearing the cistern of all those impurities, which, in spite of every precaution will be deposited, let the state of the water as supplied be what it may.

I remain, Sir, yours respectfully,

WM. BADDELEY.

29, Alfred-street, Islington.
October 13, 1842.

* If their employer was as anxious about their welfare as he pretends, could he not have supplied them with a moderate quantity of some *more generous drink*?

* I beg Mr. Stuckey's pardon, I mean no offence, to him; the expression originated with the man of bristles, and it comes in rather apropos just now.

† If I were making an Almanack I would put down against the last day in the months of March, June, and September,—"*To preserve health, clean out your cisterns and water butts.*"

THE WATER QUESTION.

Sir,—I do not know what Mr. Baddeley will say to the communication of "W. H.," in your last Number, about *his cisterns close shut down and oft cleared out;* but certainly those who sell Bohea for good Congou will feel grateful for the seasonable hint he has given them. In vain will old ladies complain that the tea is deficient in flavour: Mr. T-man will reply—"I assure you, I have not varied from the quality I have been accustomed to supply; if you find a difference, I should think *the fault must be in the water. Do you know how long it is since the water-pipes were laid down in your neighbourhood? If they have laid long, and got half-full of earthy deposits, it is unreasonable to expect that, with water through such pipes, you should obtain a fine cup of tea.*"

The Water Companies will not, however, pass him a vote of thanks for going *so deep* into the subject, and finding mud where Mr. Baddeley's besom cannot reach it. "What!" they may exclaim, "take up all the pipes, and clean them, and relay them?" *This is worse, by far, than Stuckey's Filtration Scheme!!*

By the way, Mr. Editor, "W. H." must have overlooked your former notices of this scheme, or he would not altogether despair of getting clear water; neither would he *strenuously* recommend private filtration. If he will refer to your Number for the 30th of July last, he will see what is doing in this matter for the public good; and he will also find stated a very important defect in private filtration, which will save him from estimating it above its due value. As I consider this defect worthy of the special consideration of all your readers, you will perhaps excuse me, Mr. Editor, if I refresh their memories by a brief quotation:—"Such small filters, by the slowness of the process, destroy the carbonic acid gas which is contained in the water, and without which it speedily becomes offensive, putrid, and injurious to health."

I am, Sir, yours truly,
J. Cole.

Old Kent-road, Oct. 19, 1848.

THE COCKED HAT AFLOAT.

(From the *Fifeshire Advertiser* of 15th Oct.)

At the special request of its ingenious inventor, we give the following truly graphic description of the launch of this nautical wonder, which took place, from the building-yard of Messrs. Brown, of Kirkaldy, on Wednesday last. We trust we need make no apology to our readers for its insertion, as we feel assured they will be as much delighted with the *description* of the launch, which is from the pen of Mr. Dempster himself, as they were at the *sight* itself.—Ed.*

*Launch of the Problem.*

Sir,—On Wednesday morning the 12th October, 1842, the sun rose beautifully in the east, with light southerly airs, and sea smooth as glass, comparatively speaking. This being the morning of the day that I had pledged myself to the public that the *Problem* should be launched into her native element for solution, I felt happy at having a good day for the occasion.

The *Problem* was mounted on a cradle with 4 wheels, full-rigged, with all sail set, and my four equilateral flags (each of which answers for six numbers) displayed at the different mast-heads.

At 1 p. m., being nearly low water, two fine black steeds were yoked to the cradle which supported the *Problem*, when all moved off slowly but majestically down to the water edge, amidst the loud huzzas of numerous spectators. The cradle being removed, she sank gradually down in the sand about 2½ feet, where she stood quite erect, without the assistance of anything to steady her; and, as there was but little wind, I thought proper to allow the sails to remain hoisted up, so as to gratify the many that were constantly gathering to see her, and expressing their admiration at the beauty of the rig, and their astonishment at her standing upright in the sand, with all sail set. An anchor was run out a considerable distance, to haul on when she floated.

At 2h. 30m. p. m., the tide coming in, the wind shifted round to the eastward, with an increasing surf on the beach, and at 5 p.m., the water having risen about 2½ feet round her, the sand being softened and breeze increasing, the *Problem* went very gently down upon her bilge, with all sail set: a grand sight!

The sensation which now seized the thousands who were standing on the beach, witnessing the scene, I will leave you to judge, knowing what the feeling generally is before any new invention is tested. Some swore she would never again rise, whilst others said, that was just what they expected. It was a fine joke for those who were prejudiced, you may depend upon it; whilst others, who were friendly, I believe sincerely pitied me. The sails being lowered down, as the tide flowed the boat rose gradually, just as I was aware she would, until she became upright; but as the surf by this time was

* For a description of Mr. Dempster's system of building, see *Mechanics' Magazine*, vol. xxxvi. p. 504.

running rather high, every sea that came lifted, and again left her to bring herself up easily by the point below; she made several sharp rolls from one side to the other, as the men happened to be moving about in her, which no doubt appeared to some as though the *Problem* was to be a complete failure, if not a total wreck.

At length she got fairly afloat, and swam much to my satisfaction; and, as those on shore saw her moving outwards, they uttered tremendous shouts of applause, which were answered by us on board. I immediately ran for Kirkaldy harbour, where she was allowed to take the ground, and lay down as the tide left her; when the tide flowed she rose with her gunwale three inches out of the water.

Thursday forenoon, there being a moderate breeze of wind, I manœuvred her about in Kirkaldy bay a considerable time, and I may now consider myself safe in saying that several of the most important points of the *Problem* are now solved, viz.:

1. She will rise off the ground without the water flowing into her hatchways.

2. She is less liable to take damage whilst bumping on a sandbank than any other construction.

5. She will be stiff under canvass, sail well, be very weatherly, and manœuvre in a smaller compass than any other built or rigged vessel that ever preceded this invention.

I am, Sir, Yours, &c.,
H. Dempster.

## LIGHTNING CONDUCTORS AND WIRE RIGGING—INTERESTING EXPERIMENTS AT PORTSMOUTH.

On Thursday the 13th instant, the *Orestes*, 18, Commander the Hon. S. T. Carnegie, was hauled abreast of the dockyard, Portsmouth, for the purpose of practically testing the efficacy of her lightning conductors by a series of experiments by Snow Harris, Esq., F.R.S., upon whose plan the conductors have been fitted up. She was moored about 100 yards from the jetty, between which and the ship about midway a barge was placed, containing a carronade. A wire leading from the positive side of a powerful electrical battery in the *Semaphore* was attached to a cup of gunpowder on her main truck. Another wire leading from the negative side of the battery was attached to the gun in the boat. A short wire was placed on the touch-hole of the gun, and led over the gunwale of the boat to the surface only of the water, on the side nearest the *Orestes*. There was no communication between the ship and the barge.

The object was to show that immediately an electrical discharge reached the mast-head it passed down to, and was dispersed in, the water by means of the continuous line of conductors. This was proved thus—an electric battery in the *Semaphore* was discharged, the discharge passed along the copper wire from the metallic plate on the interior of the jar to the mast-head, its presence there was rendered apparent by the ignition of the gunpowder in the cup; it passed thence down the conductor on the mast into the hull of the ship, and along the conductors on the hull into the sea. That it had arrived in the sea was proved by the ignition of the powder over the touch-hole of the gun in the boat, and the consequent discharge of the gun, because the only means by which this gunpowder could be ignited was the passage of the electricity up the short copper wire which connected the touch-hole of the gun with the sea; so that not only must the electric fluid have arrived in the sea, but it must have passed through it to this short copper wire in the boat. It is almost needless to add, that so rapid is the passage of the electric fluid, that the report of the discharge of the battery, the ignition of the powder at the mast-head, of that over the touch-hole of the gun, and the report of the gun itself, appeared simultaneous, notwithstanding the great distance traversed by the electricity; thus showing clearly and satisfactorily that the instant the explosion arrived at the main truck, that same instant did the conductors clear it of the ship and transmit it to the water.

Several experiments were then made, to prove that the principle held good in the case when the topmasts and topgallant masts were struck. These were very conclusive. The electrical current followed the continuous line, without at all diverging to those portions of the conductors which, by the striking of the masts, were placed in a position out of that line.

Wire-rope conductors were then considered, and the several objections to them fairly and conclusively stated. The danger of a man being killed in the bight of such a rope, while striking the top or topgallant mast during a thunder-squall, was most clearly proved by a very neat experiment. Such a case was represented by gold-leaf or paper, and when an electric shock was passed over the paper, the gold was burnt up in the direction of the man, but remained untouched round the bight of the rope.

The last experiment which was performed was with a view to prove at once the complete protection afforded by the continuous conductor, and the apparent impossibility of the least action taking place on metallic bodies out of it; thus practically refuting the supposition of any lateral discharge taking place. A model of a mast, about 10 feet in length, was made in parts, and an interrupted line of metal placed in the heart of it. Percussion powder, which it is well known will inflame with the least spark of electricity, was placed between these interruptions. On the outer surface of the mast a continuous conductor was placed, the extremities of which were connected at each end of the model of the mast with the extremities of the interior and interrupted line of metal. In order to make the experiment more complete, bands of metallic leaf were made here and there to surround the mast as hoops, together with other metallic bodies which could enter into the mast itself, and touch the internal line of metal. An intense shock of electricity was allowed to fall upon the upper extremity of the mast, where both lines of metal were in conjunction, with the view of discovering (since the electric matter had thus, it may be said, the choice of two lines) whether it would pass upon the metal within, or whether it would be dispersed between the two lines and pass down each, or whether it would only pass down the exterior line, and whether in passing down that line it could cause a lateral discharge to enter the mast, or in any way to affect the interior. This was a severe test, from the highly inflammable nature of the percussion powder, and it succeeded perfectly. As long as the continuous external conductor remained perfect the discharges of electricity were innoxious; when, however, the exterior conductor was removed, and a similar charge was thrown over the model, the mast was blown to pieces by the ignition of the percussion powder, evidently proving that if the previous discharges had in any way, or under any form, pervaded the interior, this effect would have resulted in the very first instance.

In repeating the experiment of passing the electric fluid through the Orestes, an accidental circumstance fully proved Mr. Harris's theory, that metals of themselves are not attractive, and that lightning will take the most direct continuous way to arrive at its course. The wire which led from the Semaphore to the cup containing the gunpowder at the mast-head of the ship was not properly placed, the bight touching the mast a few inches below the cup. The discharge, therefore, instead of continuing along the wire to the cup, was conveyed to the conductor at the spot where the bight touched the mast, and carried through the ship, and thence by the seat to the boat where it fired the gun, leaving the gunpowder at the mast-head unexploded.

After Mr. Harris had concluded his experiments, Admiral Sir Edward Codrington said, that after what he had witnessed, he thought it but right publicly to observe that he felt perfectly convinced of the efficacy of the conductors upon Mr. Harris's plan, which, after the conclusive and satisfactory tests they had that day undergone, would no doubt be generally used throughout the navy.—*Times.*

## NOTES AND NOTICES.

*Sale of the Great Western Steam-ship.*—On Monday last the steam-ship *Great Western* was offered for sale by public auction in Bristol. The bidding was very spirited, but she was ultimately bought in at 40,000*l*. The attempted sale of this powerful steam-ship gave rise to a rumour that she would not leave Bristol for New York on Saturday next, the 22d inst., as previously advertised. We have, however, reason to believe there was not the slightest foundation for such report.—*Times.*

*Wonderful—If True.*—Mr. Samuel Colt made an experiment with his terrible Explosive Engine, at Washington, on Saturday, Aug. 27, which is said to be completely successful. A vessel prepared for the purpose was shivered to atoms *at a distance of five miles.* It was a repetition, on a large scale, of the experiment he performed off the Battery, at New York, on the 4th July. There was an immense concourse of spectators present, including the President Heads of Departments, and the Mayor of Washington. Mr. Colt was near Alexandria; a signal gun was fired at Washington, and in about twenty seconds thereafter, a huge column of water rose suddenly into the air, and when it descended not a trace of the vessel was to be seen.—*American Papers.*

*The Gold Mines of Russia.*—Russia now yields four times as much gold as all the rest of Europe, and the yearly produce of this metal (400 poods, or 16,000 lbs.) is sufficient to load from forty to fifty sledges. The silver needs for its conveyance a caravan of from 120 to 150 sledges. The platina requires but three or four, and the copper, which is also conveyed chiefly by land, sets in motion 5000 sledges. By far the greater part of these metals comes to the mint in Petersburgh.—*Kohl's Russia and the Russians.*

*New Paper Hangings.*—A Liverpool paper thus describes a new style of paper hangings, recently introduced there from Switzerland. The effect must be very fine:—"The general character of the design may be styled Florentine; the ground work is white satin; the walls are divided into compartments by stiles of a rich gold colour, representing, with great accuracy, carved wood of intricate design; the panels are niches with drawings of deer, lions, swans, &c., each forming a complete picture in gorgeous borders of gilded ornaments and flowers, partaking somewhat of the Louis Quatorze style; the alternate panels comprise a species of filigree work, varied with drawings of flowers and gems, in which gilding is most tastefully and sparingly introduced, the whole being of the most exquisite design and execution. An exceedingly rich border runs round the top of the room, and one of a corresponding design round the bottom part. From the judicious employment of French greys and other cool colours, the effect is not in the least gaudy, but at once rich and chaste. The introduction of this paper may be regarded as a new era in decoration, and will do much to relieve us from the sameness and insipidity which pervade even our best houses."

*Foul Air in Mines.*—Mr. Hardiman, a gentleman who made several experiments with Dr. Payerne in the diving-bell over the wreck of the *Royal George* at Spithead, has been trying other experiments at the Royal Polberou Consols' Mines, in St. Agnes, with the newly-invented method of purifying the air. The experiment was made at a depth of about 700 feet below the surface, and where the air was previously so vitiated that no person could approach the place, (a rise nine fathoms above the level,) a powerful air machine attached to the engine rods was put to work some time ago, which barely furnished air for three men with candles to exist. The method of purifying air was brought into action after this air machine had been thrown out of use, and although there were at that time no less than 15 men with candles in the rise, the air in ten minutes was so renovated that all breathed with comparative ease; the improvement was even visible, inasmuch, that where three candles were until then with difficulty made to burn, ten or more now burned freely. As a further test, two holes were blasted, and under the old method no man could approach the top of the rise until half an hour after the explosion, and in some cases longer, but the machine so quickly dissipated the smoke that in four minutes the men were at their work breathing air comparatively pure, and refreshed with the additional advantage of being as cool as at the surface, although there were, as before stated, 15 men in the rise.

*Wreck of an Iron Steamer.*—The *Brigand* iron steamer, of 600 tons, and 200 horses power, has been unfortunately lost on the Scilly Islands. From the following account of some of the circumstances of the disaster, it will be seen, that to the excellent system adopted in iron ships, of building them in several distinct water-tight compartments, the passengers and crew were in this instance, most probably, indebted for their lives. "The *Brigand* sailed from Liverpool for London at 2 o'clock on Monday afternoon, and proceeded safely on her voyage until 5 o'clock on Wednesday morning, when they saw the St. Agnes' light, which, from the refraction of light, the weather being very hazy, they conceived to be at a considerable distance—they were then steaming at 12 knots an hour: suddenly the man on the look-out at the bow sang out "Breakers ahead!" which they distinctly saw, but too late, unfortunately, for the rate at which they were going was such that they could not stop her; and, although they put the helm hard a-port, to endeavour to shave the rock, the vessel immediately afterwards struck most violently, and two plates of the bluff of her bow were driven in. She rebounded from the rock, but in an instant afterwards she struck again, broadside on, the force of which blow may be in some measure conceived from the fact, that it actually drove a great portion of her paddle-wheel through her side into the engine-room. The vessel was built in four compartments, the plan adopted in iron ships, or she would have gone down instantly, two of her compartments being now burst, and the water rushing into them at a most fearful rate. By the two shocks four and a half plates were destroyed, and four angle-irons were gone in the engine-room. The two compartments aft being, however, still water-tight, she continued to float, and every exertion was used by her commander, Captain Hunt, for upwards of two hours, to save her, when the crew took to the boats, and shortly afterwards she went down, about seven miles from the rock, in about 45 fathoms of water."



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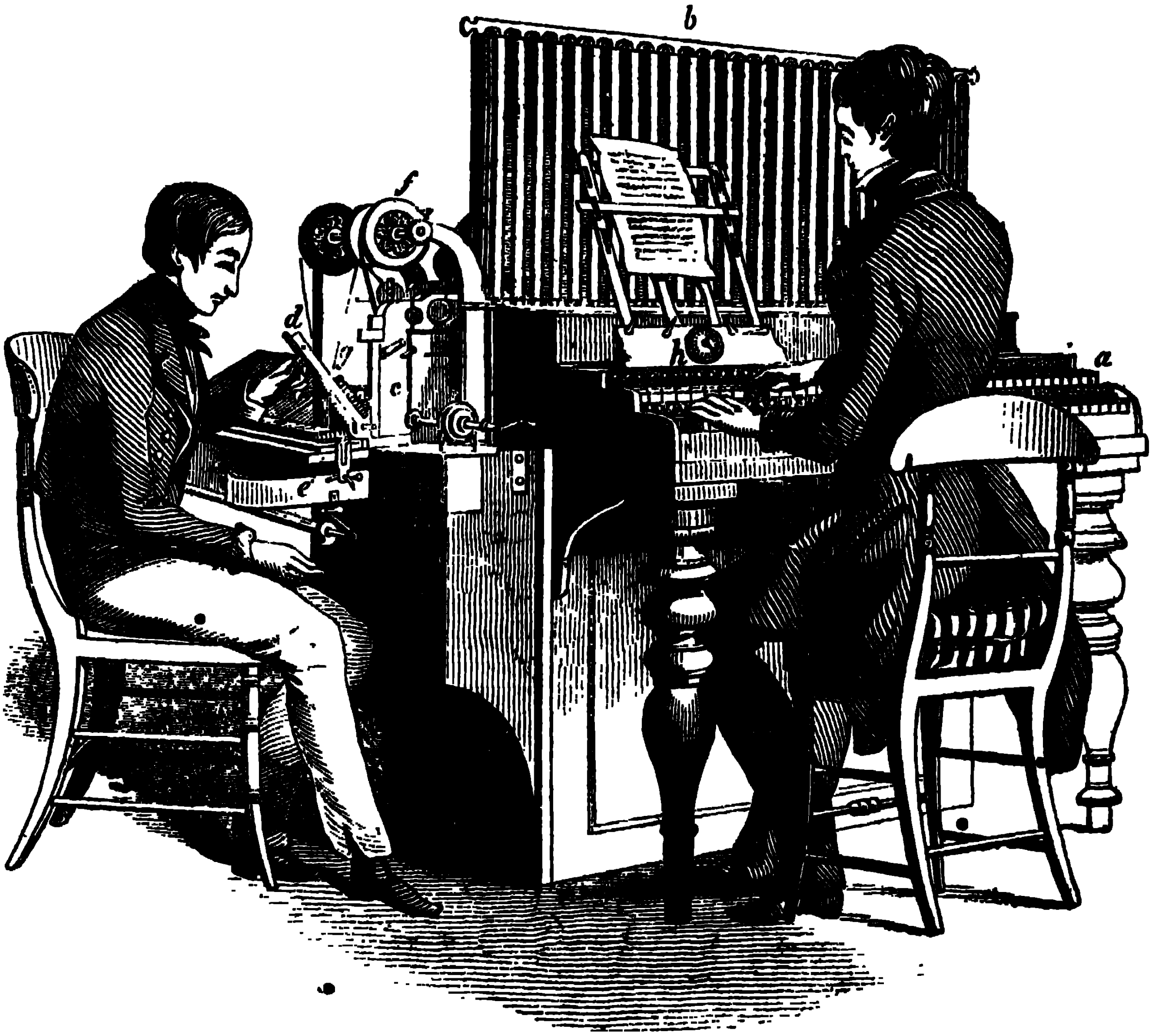
## ROSENBERG'S TYPE COMPOSING AND DISTRIBUTING MACHINES.

Fig. 1.



## ROSENBERG'S TYPE COMPOSING AND DISTRIBUTING MACHINES.

We not long ago described a type-composing machine, invented by Messrs. Young and Delcambre, (see *Mech. Mag.*, No. 985, June 25, 1842,) by which the art of setting up types seemed likely to be greatly assisted: not that it promised to supersede the use of hands altogether in this branch of labour, but because it offered the means of producing much more work in a given time, by less skilled, and consequently more cheaply paid, hands than those at present required. Two females and five very young boys were stated to be able, after only six months' practice, to compose and distribute 6,000 types an hour, which was supposed to be equal to the work of at least three able-bodied men of good education, on the present system; and the consequent reduction in expense was estimated to be from 4*d.* to 2*d.* per 1,000 (brevier.) The machine of Messrs. Young and Delcambre, it may be remembered, did no more than set up, or compose, that is, arrange the types in their proper order of sequence; the justifying, the imposing, the correcting, and the distributing, had all still to be done by hand, in the usual way.

We have now to present to the notice of our readers a couple of machines invented and patented by Captain Rosenberg, by which a very considerable advance appears to have been made in this line of mechanical invention. The setting-up of the types, which Messrs. Young and Delcambre were only able to do at the rate of 6,000 an hour, Captain Rosenberg states he can do at the rate of (at least) 10,800; and the distribution of the types, which, under Messrs. Young and Delcambre's arrangements, furnishes occupation for four hands, (boys,) Captain Rosenberg does by means of *one*, with the aid of machinery. We have ourselves had the pleasure of seeing Captain Rosenberg's machines in operation; and though our opportunities of observation have not been such as to enable us to subscribe to his numerical estimate of their capabilities, in its full extent, we have no hesitation in bearing our testimony to this much—first, that his setting-up process is a good deal quicker than that of Messrs. Young and Delcambre; and, second, that he does distribute by the aid of machinery, in a manner remarkable at once for its great ingenuity and perfect efficiency.

Fig. 1 on our front page is an exact representation of Captain Rosenberg's composing machine, as seen by us in operation; and fig. 2, a similar representation of his distributing machine.

### 1. *The Composing Machine.*

The pianoforte resemblance of this machine to that of Messrs. Young and Delcambre will at once strike the reader; but it is only fair to both parties to observe, that neither of them lays claim to any originality in this respect. It is a form common to nearly all the inventions of this class.

*a* are the keys, on which the chief compositor performs, each key answering a particular letter, which is engraved upon a small ivory button, fixed above each key.

*b*. Rack-frames, consisting of a series of vertical rails, by which compartments are formed, (one for *a*'s, one for *b*'s, and so on,) into which the letters are placed, as they are lifted from the distributing machine, (afterwards described.)

*c*. A receiver, to which all the types are conveyed, and in which the line is formed into words and sentences.

*d*. A justifying-stick, into which each line, when complete, is removed from the receiver *c*, for the purpose of being read over and justified by an assistant-compositor.

*e*. A galley, into which the assistant-compositor causes each line to slide down from the justifying-stick, after it has been justified, for the purpose of being spaced out.

*h*. A counting apparatus, by which the chief compositor is informed when each line is completed. This apparatus consists of a dial-plate and two hands. The plate is divided into inches and eighths of an inch. One of the hands is moveable, and must be placed at starting upon one of the marks, indicating the length of the lines, or width of the page to be composed. The other hand is so connected with the key movements, that it advances a distance equal to the thickness of each type composed, so that when it comes immediately above the other, that gives notice of the line being complete, when

it is instantly removed by the compositor, and another begun. There is also a hammer, which strikes a small bell, as a warning to the compositor, a moment or two before each line is completed.

The mode of working with the machine is as follows. The chief compositor, who sits at the front of the machine, having his copy before him, performs upon the keys as he reads. By the action of the keys, the corresponding letters are forced out from their respective compartments, and are laid down upon an endless belt or chain, which is constantly passing through the middle of the machine, from the right towards the left. By the motion of this chain, the types, when liberated and placed upon it, are very quickly conveyed into the receiver, where, by the action of a small eccentric, which is revolving at a considerable speed, the types are deposited horizontally, one above the other, in the same order as the keys are performed upon, and are thus formed into lines, the lines being supported by a T-shaped slider, which is caused to recede in the same proportion as the types accumulate upon it. As each line is completed, (of which the compositor is informed by one of the hands upon the dial, and warned by the bell as before stated,) the compositor takes hold of a small winch by his left hand, (which is seen in the figure in the front of the receiver *c*,) by turning which the line thus completed is lowered to the bottom of the receiver, while by moving with his right hand a lever, (not seen in the figure,) the line is removed from the receiver into the justifying-stick *d*. The time consumed in this operation is less than a second. As soon as the line is removed into the justifying-stick *d*, the assistant-compositor, (as shown in fig. 1, at the left end of the machine,) detaches, with his left hand, the upper end of that stick, (its lower end being movable upon a fulcrum, as represented at *g*,) and having lowered it into a horizontal position, he reads the line, (the types standing now in a *vertical* position.) Having corrected such faults as may have occurred during the composition, he, by removing a slider, which constitutes the bottom of the justifying-stick, causes the line of type to drop down at once from that stick into a galley, *e*, where he spaces it out.

At the back of the machine, and near to the assistant-compositor, is placed a small table with compartments in it, containing the different sizes of spaces which may be requisite for the spacing out of the lines. There is also another table on his right, with compartments, containing all the different sorts of types, for the purpose of giving him access to any letter, stop, figure, or sign, that may possibly have been omitted by the chief compositor. (Neither of these tables is shown in our engraving.)

The principal feature of *novelty* in this machine is, the endless chain on which the types are deposited, and by which they are conveyed into the receiver, and the advantages attending it are these :—

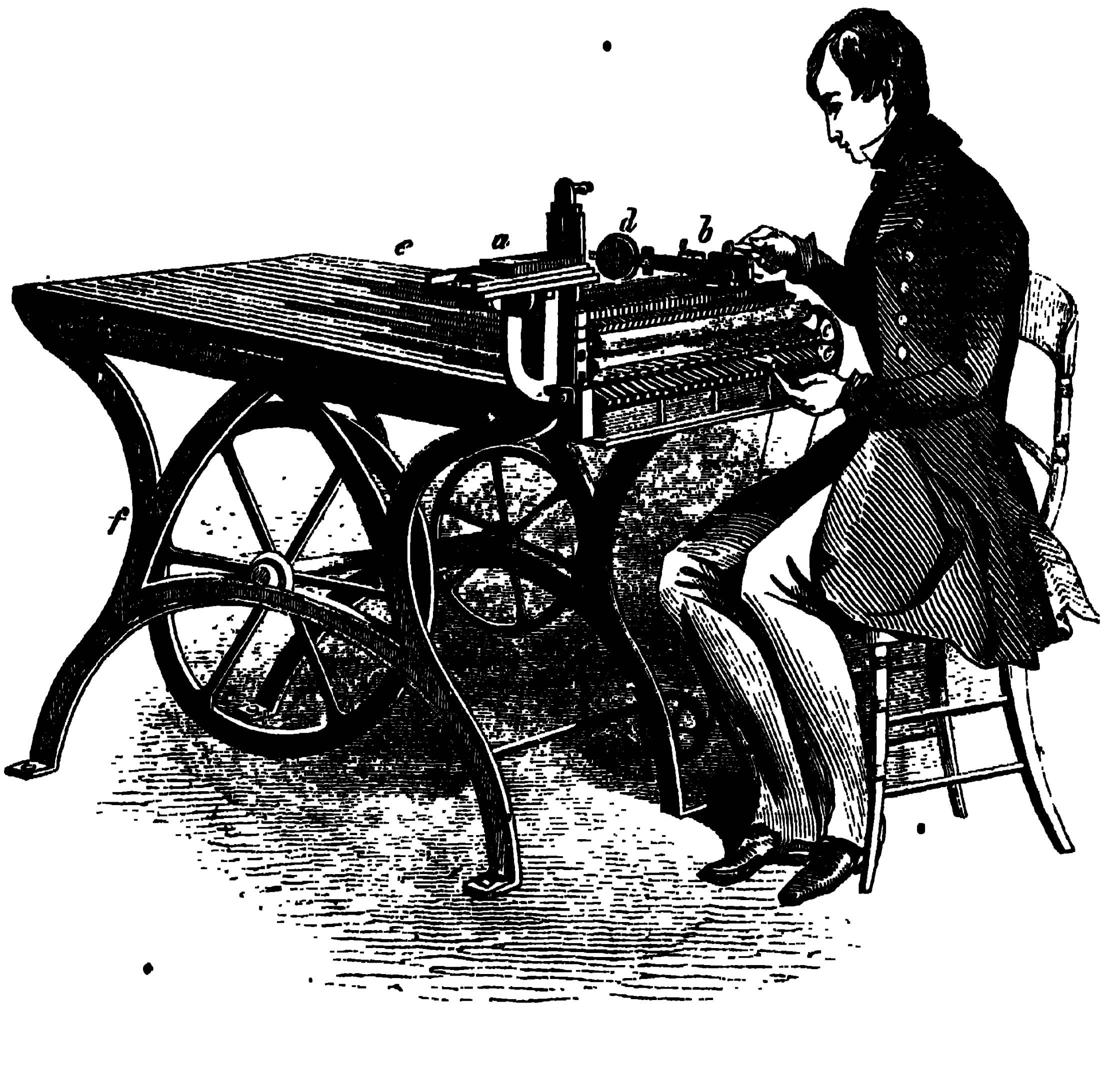
First, the types, instead of descending, as in Messrs. Young and Delcambre's machine, by their own gravity, through variously-curved channels in an inclined plane, at some risk, (though small, perhaps,) of derangement, and at a certain considerable loss from friction, are carried forward in a straight line by the endless chain, free from all chance of disturbance, and subject to little or no friction.

Second.—In Messrs. Young and Delcambre's machine, it is necessary that each type should have the start, down the inclined plane, of the type that is immediately to follow it, and of course the compositor can set but one type at a time. In Mr. Rosenberg's machine, however, as many letters may be set at once as happen to follow in uninterrupted alphabetical sequence, and, in practice, there is a vast number of words and syllables which the compositor soon learns to dispose of in this way, by one stroke on the keys. For example, *act*, *add*, *all*, *accent*, *adopt*, *envy*, are words, the letters in which following in their natural order, may be set up by one pressure of the hand on the keys; the endless chain carries the types forward in the order in which they were deposited upon it, and nothing can occur to disturb that order. So also with such syllables as *ab*, *eff*, *dem*. *opp*, and *ly*. The saving in time from the use of such *accords*, (as they are termed,) both as compared with Messrs. Young and Delcambre's machine and with ordinary composing, may be thus illustrated. The word *accentuation* contains twelve letters, and would require *twenty-four* movements of the

arm of a compositor to set up in the ordinary way; but with Captain Rosenberg's machine, it is set up with only three strokes on the keys, as thus, *accentu-at-ion.*

Captain Rosenberg states that he has proved, by actual trials, that his machine is capable of delivering, or clearing out types, (supposing them to be composed without regard to order of sequence,) to the amount of 400 in a minute, or 24,000 in an hour. Already a young man, with only a few months' practice, and without a previous knowledge of printing, is able to set-up about three lines of brevier in a minute, each line containing about 60 letters and spaces, (this we witnessed,) and assuming that

Fig. 2.




he is able to do so for a continuance, this is equal to about 10,800 in an hour.

But here a question of importance arises. Can the types be justified as fast as they can be composed? For it is evident that the speed with which the justification can be accomplished must, of necessity, be the greatest speed at which it can be of any use to set up the types. The answer to this question must, we apprehend, be in the negative. The justifying is visibly a slower process than the composing. It was admitted to us, that, for a continuance, the assistant-compositor could not easily justify more than 150 letters in a minute, which is equal to 9,000 an hour, which falls short of what the composing-machine can set up, by 1,800. We think it likely that means may be found to accelerate the

justifying process; but the advantage of Captain Rosenberg's machine over that of his rivals, in respect of celerity, must for the present be considered as reduced, by the justifying process, to the difference between 6,000 and 9,000 an hour; leaving still, however, a gain of 50 per cent.

2. *The Distributing Machine.*

This machine, represented in fig. 2, is quite detached from the other, and worked independently of it.

*a* is the galley into which a portion of the page or column of type, after having been printed off, is transferred.

*b* a travelling-carriage, into which the lines are lowered from the galley *a*, line by line, by means of a slider with a handle on it, (seen at the top of the galley). From this carriage, the different letters are distributed, by the action of the machinery, into separate receptacles provided for them.

*c* are keys, with the letters of the alphabet engraved upon them.

*d* a box, fixed to the end of the travelling carriage, containing a convolute spring, by the effect of which the line of type in the carriage is continually pressed against the front of the carriage, until the last type in the line is delivered.

*e* grooves, made in an horizontal plate, into which the types are received, when distributed from the carriage *b*. In these grooves the types are formed into long lines, (one sort of letters in each line,) by the revolving motion of a small cam or eccentric, working at the end of each groove. (This part of the machinery is necessarily omitted in the engraving.)

A line of type having been lowered from the galley *a*, into the carriage *b*, the distributor takes hold of the handle on this carriage by his right hand, and moves it towards the right. He then reads the line over, and having, by the forefinger of his left hand, raised the key belonging to the letter, which now is nearest to the front of the carriage, he moves the carriage to the left, until it is stopped by the action of the key he has thus raised. The effect of this is, that the letter corresponding to that key is, through the machinery, forced out from the line, and falling down through a recess which is made to receive it, is guided into its own groove in the horizontal plate *e*, when by the action of the small eccentric or cam (working at the end of each groove) it is instantly pushed forward, for the purpose of giving room for the next type to fall down.

In this manner the types are distributed and arranged into lines, all the *a*'s in one line, the *b*'s in another, and so on, ready for being replaced into their corresponding compartments in the composing-machine. This operation of replacement is performed through the medium of an instrument, denominated "*the feeding-stick*," by which 200 or 300 letters may be lifted at once from the distributing-machine, and transferred to the composing-machine.

The number of letters which a lad, with the aid of the machine, can distribute, and replace in the composing-machine, is only 6,000 an hour; but this would offer no hindrance to the general operations of any printing-office adopting the system of composing by machinery, for there might be as many more distributing-machines employed than composing-machines, as the relative speed of the two required; for instance, three of the one for two of the other, five for three, and so on.

The cost of Captain Rosenberg's two machines must, we think, be greater than that of Messrs. Young and Delcambre's one; but on this point we are without the data requisite to enable us to speak with confidence. Captain Rosenberg himself is of a contrary opinion. The machines now shown at work (9, Howard-street, Norfolk-street, Strand) are the first complete ones of the sort, and what they may have cost furnishes, of course, no criterion by which to judge of the price at which they could be manufactured in considerable numbers for sale.

## ON THE ACTION OF AIR.

Sir,—Although this subject has, in some degree, engaged the attention of philosophers, yet it has not got so large a share of their consideration as it merits. To the action of air, in its various conditions, I am persuaded all the phenomena of heat, electricity and magnetism, are referable. It is not necessary to have recourse to the imaginary agent called heat, to explain the effects produced by fire: they, evidently, are caused by the action of atmospheric air, and its seve-

ral modifications, coming under the denominations of combustible gas, and gas which supports combustion. It is as clear as two and two make four, that the effects of the burning-glass are produced by the joint action of solar light and atmospheric air; and that, the combustion originated by the lens will proceed without the aid of solar light, and by the action of the atmosphere alone. No combustible thing can be ignited in the absence of air. Gunpowder cannot, by any means, be exploded in vacuo. I have seen the finest gunpowder lie on a red-hot wire, in vacuo, until the wire melted; without either exploding, or igniting, or being, in any way, perceptibly affected. And I have seen the same gunpowder taken out of the receiver and exploded in air, by the remnant of the same wire, ignited by the same galvanic battery—for that was the source whence the fire was derived. If the vacuum be imperfect, that is, less complete than it might be, (for a perfect vacuum is unfeasible,) the gunpowder, after being in contact with the connecting wire for a while begins to smoke and burn; effects which are caused, partly by the air in the receiver, and partly by the air which issues out of the wire. Gunpowder may be exploded under water, if a sufficient quantity of atmospheric air be put down with it; but no explosion, under water, can be had without air. If a little gunpowder be put in a glass bottle, and the bottle be then corked and sunk in water, the powder may be exploded by light; that is, by a lens. But if the powder be put in the bottle, and the bottle be then filled with flour, or fine sand, firmly rammed down, so as to exclude all air from the powder; and the bottle be then corked and sunk, the powder will not explode; nor can it be ignited. Now these facts clearly prove that, the noise, the concussion, the fire and light, and the disperson of matter, which accompany, and, in fact, constitute, the explosion of gunpowder, are produced by an action or operation of the atmosphere.

It may be asked, if air be necessary to ignition, and fire be air in a state of radiation, whence comes the fire in the connecting wire of the galvanic battery, in the exhausted receiver, where it will be said, there is no air? The answer is, that it arises from the confluence of the columns of aëriform fluid which come from the battery, pass through the conducting wires, meet in the connecting wire, and there, by their concurrence, and the pressure arising from it, produce the fire perceived. If the ends of the conducting wires be dipped in water, aëriform fluids or gases, called oxygen and hydrogen, come from them, which are supposed to be, somehow, formed from the water. With this opinion, however, I do not agree. I think these gases are derived, mediately or immediately, from the atmosphere; that they are but modifications of that element; and that, they come from the battery, through the conducting wires. I think so, because the fluid appears to issue from the wires, and is susceptible of diversion at any part of them; because, atmospheric air can be sent through many kinds of wood and stone by atmospheric pressure alone; and because, all metals prepared by fire, such as copper, steel and iron, necessarily are saturated with air.

The ebullition of boiling liquids is caused by air which comes through the substance of the vessel in which the liquid boils. If a common drinking glass be immersed in a vessel of oil, and the mouth be then turned downward in such a manner as to exclude all air from the interior of the glass, and leave it occupied by the liquid, and the vessel be then put on the fire to boil, the air will gradually drive out the oil, and take possession of the glass. The result will be the same, if milk, or water, or, I apprehend, any other liquid that will boil, be used instead of oil.

By compression, air produces the phenomena of light and heat; for instance, the sparks from percussion arise from the compression of atmospheric air in the parts of the substances brought into contact by the percussion. The radiation of the spark, is an action whereby the condensed air recovers its equilibrium; and the effects which the spark is capable of producing, are caused by that radiation. This is proved by the fact that sparks can be obtained only from percussion in air; or from substances saturated with air. From flint and steel, which produce an abundance of brilliant sparks, when struck in air, no spark whatever can be obtained in vacuo. This is shown by screwing the lock of a gun to the plate of an air pump, exhausting the air, and drawing the trigger. All substances, at the earth's

surface, are saturated with air, and some of them, such as agate and quartz, are extremely tenacious of it; but it may be extracted from them. Two pieces of agate or quartz, rubbed together under water, give out light by a sort of coruscation; which arises from the compression of air in the angles and parts of the substances brought into collision by the operation. For, if the substances are put in a vessel of water, about 18 inches deep, covered with a lid, and placed in a dark room, so as to exclude every ray of light, and thus kept for four or five months, the water will saturate them, and expel the air from them, and they will then afford no light under water. If, however, light be admitted to them, while in the water, they will continue to give light.

Iron and steel, from the method of preparing them, seem to be saturated with a species of hydrogen; hence, we may understand how they burn in oxygen: namely, by the union and ignition of the two gases.

Animal radiation, or animal heat, as it is called, seems to arise from the compression of air in the lungs.

Solar light appears to be the power which moves the earth, both on its axis, and in its orbit.

In support of these views, allow me also to refer to the following papers in the *Mechanics' Magazine*, viz., a paper "On the Action of the Atmosphere," signed W., in No. 698, vol. xxvi.; a paper "On Heat, the Action of Light and Atmosphere, and on the Distribution of the Atmosphere over the Earth's Surface," signed W., in No. 716, vol. xxvii.; a paper "On the Action of Light and Air, and the Distribution of the Atmosphere over the Earth's Surface," signed W. in No. 800, vol. xxx.; a paper "On Vaporization," signed W., in No. 821, vol. xxxi.; a paper "On the Action of Light and Air, and the Distribution of the Atmosphere over the Earth's Surface, signed W., in No. 921, vol. xxxiv.; and especially to the last of them, and to say that they are my papers.

I am, Sir,

Your most obedient servant,

G. WOODHEAD.

Mottram, near Manchester.

## AN IMPERIAL BUSHEL OF SOVEREIGNS.

Sir,—The beautiful new sovereigns of the present reign, being fresh from the Mint and of uniform thickness, a good approximation may now be made, to what may be termed an imperial bushel of sovereigns.

Those acquainted with geometry will readily see, that if a sovereign be laid down as a centre, six others may be placed around this, so that the six shall all be in contact with each other, and also with the centre one; after this, if other circuits of sovereigns continue to be laid round, placing segments between segments so that no spaces are left but the small triangular ones between every three sovereigns, the arrangement will be that of a series of concentric hexagons, each circuit exceeding the last by six in number, and the hexagonal form becoming more beautifully developed the farther we proceed from the centre.

Let us then assume this hexagonal form as the most proper one for our bushel, and taking the following series, 1 + 6 + 12 + 18 + 24 + 30 + 36 + 42 + 48 + 54, we shall obtain 271 as the area of the bushel in sovereigns. In the above arrangement, we shall have 19 sovereigns in a straight line, from any angle of the bushel diametrically across to its opposite angle, and these 19 sovereigns will measure 16·36 inches in length; but as the sovereigns at each end of this line will not fit into the angles of the bushel, we must take twice the ·07 and add to 16·36 making 16·5 inches, which will be the diameter of the circumscribed circle, the half of which, or 8·25 inches will evidently be the side of your bushel.

That this bushel of 8·25 inches in the side may hold imperial measure, its depth must be 12·544 inches, and I find it will take 203 sovereigns laid flat together to fill up this depth; therefore, 271 x 203 = 55013, the total number of sovereigns such a bushel will hold.

In the proportion of breadth to depth, this bushel will be found to vary but little from that in common use for the measurement of corn, and perhaps it will be proper to state also, that my measurements were taken with a scale beautifully divided to 100 of an inch by an eminent London divider.

Should there be found to be any originality in this calculation, perhaps you will do me the favour to give it a place at

some convenient opportunity, in your very useful and widely-circulated Magazine.

I am, Sir, your obedient servant,

J. Loose.

Wolverton, September 15, 1842.

## LIFE ASSURANCE.

Sir,—The equation or formula which I gave in No. 921 of your excellent Journal, for finding the present value of one pound, depending on any age, for any short period, (not exceeding ten years where great accuracy is required,) and for any rate per cent., I now find may be much simplified, and at the same time made to give a nearer approximate value of P. The theorem is,

$$P = \frac{1}{r} - \left(\frac{d\,(w+1) + \frac{a-d}{R^n}}{ar}\right)$$

and this equation, in the case of De Moivre's hypothesis, becomes $P = \frac{1}{r} - \left(w + 1 + \frac{a-n}{R^n}\right)\frac{1}{ar}$; and if for the whole duration of life, then $\frac{a-n}{R^n}$ vanishes, and $P = \frac{1}{r} - \frac{1}{ar}(w+1.)$ These theorems are much simpler than those given by De Moivre himself, and it may be observed that they are strictly true when the decrements of life are constant. The letters $a$, R, $r$, and $n$ have the usual signification, and $w$ is the present worth of an annuity of one pound for $n - 1$ years. The demonstration of the theorems is very simple, and is as follows. Assume

$$s = \frac{a-d}{R} + \frac{a-2d}{R^2} + \frac{a-3d}{R^3} + \text{\&c., to } \frac{a-nd}{R^n}$$

$$\therefore \frac{s}{R} = \qquad \frac{a-d}{R^2} + \frac{a2d}{R^3} + \text{\&c.,} \frac{a-nd}{R^{n+1}}$$

Hence, by subtraction,

$$s - \frac{s}{R} = \frac{a-d}{R} - d\left(\frac{1}{R^2} + \frac{1}{R^3} \quad \frac{1}{R^4}\text{\&c.,} \frac{1}{R^n}\right) - \frac{a-nd}{R^{n+1}}$$

Consequently, $s = \frac{1}{r}\left(a \pm d - d\left(\frac{1}{R} + \frac{1}{R^2} + \frac{1}{R}\text{ \&c., } \frac{1}{R^n} - 1\right) - \frac{a-nd}{R^n}\right)$

But $\frac{1}{R} + \frac{1}{R^2} + \frac{1}{R^3} + \text{\&c., to} \frac{1}{R^{n-1}}$ is the present worth of an annuity of one pound certain, for $n - 1$ years, and is therefore given in the Tables. Let it be recognized as $w$; then $s = \frac{1}{r}\left(a - d - dw - \frac{a-nd}{R^n}\right)$ Hence, $P = \frac{s}{a} = \frac{1}{ra}$

$$\left(a - d - dw - \frac{a-nd}{R^n}\right) = \frac{1}{r} - \left(d\,(w+1) + \frac{a-nd}{R^n}\right)\frac{1}{ra}$$

Q. E. D.

*Example* 1.—Required the present worth of an annuity of 1*l*., depending on the life of a person aged 20, for 7 years, interest 5 per cent—probabilities from the Carlisle Tables, and the first payment in advance.

$$\text{Here } d = 42\tfrac{1}{2},\ n = 6,\ w + 1 = 5{\cdot}3294;$$

$$R^n = 1{\cdot}340095,\ nd = 5836 \text{ and } a = 60\ 90,\ r = {\cdot}05;$$

$$\therefore P = 20 - \left(42\tfrac{1}{2} \times 5{\cdot}3294 + \frac{5836}{1{\cdot}340095}\right)\frac{1}{304{\cdot}5} = 4{\cdot}9572$$

$\therefore$ 4·9572 + 1 = 5·9572 is the required value, which, by another method, we find to be true in every figure.

*Example* 2.—Required the value of an annuity of 1*l*. on a life aged 34, according to *De Moivre's Hypothesis*, rate of interest 4 per cent.

In this case $a = 86 - 36 = 50$, the complement of life; and $w + 1 = 22{\cdot}3414$. Hence $P = 25 - \frac{1}{2}(22{\cdot}3414) = 13{\cdot}8293$.

The present value of 1*l*. by the Car-

lisle Table, for the same age and rate per cent, is 15·856.

De Moivre supposes 86 years as the maximum limit of life; but the value of life annuities computed from this hypothesis gives results even lower than those deduced from the Northampton Table, with the exception of the values on very young or old ages. If, instead of 86, we take 96 as the maximum age, the results will be more in accordance with the Carlisle Table, which, with some slight modifications, is now used in many of the London Assurance Offices.

*Table showing the Values of an Annuity of* 1*l. on a single life, according to De Moivre's Hypothesis, and De Moivre's Hypothesis Modified; also, the Northampton and Carlise Tables: interest* 3 *per cent.*

| Age. | De Moivre. | De Moivre Modified. | Carlisle. | Northampton. |
|---|---|---|---|---|
| 10 | 19·686 | 21·073 | 23·512 | 20·663 |
| 20 | 18·458 | 19·867 | 21·694 | 18·638 |
| 30 | 16·800 | 18·458 | 19·556 | 16·922 |
| 40 | 14·842 | 16·801 | 17·143 | 14·848 |
| 50 | 12·511 | 14·841 | 14·303 | 12·436 |

I am, Sir, yours, &c.,
GEORGE SCOTT.

Cochrane-terrace, October 4, 1842.

## SPONTANEOUS HEATING OF CAST IRON.

Sir,—With regard to the spontaneous heating of cast iron, several instances are reported; for instance, Professor Daniel, in examining a cube of grey cast iron, by muriatic acid obtained a porous spongy substance; untouched by the menstruum it was easily cut off by a knife, had a dark grey colour like plumbago, and when placed in considerable quantity on blotting paper to dry, it spontaneously heated, ignited, and scorched the paper: its properties were not impaired by being left for weeks in the solution of iron or in water.

Mr. D. Williamson, in his work on "Engines of War," states than an iron gun of the Florida, of the invincible Armada, sunk off one of the western islands of Scotland (Mull) when raised by Sir Archibald Grant and Captain Roe in 1740, became red hot in less than a quarter of an hour, and was cool in three hours; also that a gun raised off Carlscrona, having been in the sea 50 years, became very hot on exposure to the atmosphere: one third was converted into a mass very like plumbago. Mr. Dean raised some cast-iron guns and balls on the June 16th, 1836, from the Mary Rose, sunk off Spithead, July 18th, 1545, which became very hot and fell to pieces. Balls of 30 lbs. were reduced to 19·8 and 70 lbs. balls to about 45 lbs.

Perhaps some person would inform us, through the medium of your Journal, whether any similar phenomenon has been observed with regard to the cast iron raised from the wreck of the *Royal George*, and if so, what is supposed to be the cause, and the chemical action that takes place. Is it that the heat becomes susceptible by reason of any sudden contraction? Or does the cast iron become minutely divided, and therefore its affinity for oxygen so much increased as to take fire in the atmosphere?

I remain, Sir, your obedient servant,
I. K. F.

October 20, 1842.

RAILWAY REFORM.

Sir,—There is a standing jest among those who love to laugh at philosophers, about Sir Isaac Newton's having caused a hole to be cut in his study door for his cat to come in by, and by its side another for her kitten; a story which, as the Italians say, "*se non e vero, e ben trovato.*" Now, however ridiculous this may seem, something like a parallel to it may be seen on all our railroads, which, to the great cost, and almost ruin, of their shareholders, have been made double, when a single one might have sufficed; for in order to work a single railroad with as much efficacy as a double one, we have only to construct, at about half its length, a single sinuosity, either to the right or to the left, to enable the train coming up, to pass the train going down, and take its place, and, *vice versa*, the opposite train. And this passage might be safely used by making a short halt at each end of the sinuosity. To accomplish this great saving, it is only necessary that the two trains should always start at the same hour, and stop at each end of the sinuous curve, until by a signal one train enters the curve, and the other proceeds in a straight line. I need not, I believe, take up more room in your useful Magazine by detailing the immense saving that would accrue by this simple and not expensive process, as it is evident it would nearly reduce the whole expenditure by one half; and if constructed on a plan, the model of which I have just sent to France and Germany (for in England we never adopt new plans in great works), which includes a great saving in the transverse sleepers, as well as an additional security in the construction of the wheels which support the engine, and would also reduce the expense considerably, whilst it would render the railway more lasting, and easier to be laid down, than any that has as yet been adopted to my knowledge. You will oblige me by inserting this in your next Magazine, and if any of your correspondents are desirous of seeing my new plan, and you can make room for it, I shall have great pleasure in sending it for your pages.

I am, yours, &c.,

GEORGE CUMBERLAND, SEN.

Oct. 20, 1812.
Culver-street, Bristol.

[The plan of our esteemed correspondent is so simple as hardly to require any further explanation; at the same time, we shall be glad to receive from him any additional elucidations which he may think likely to be of interest to our readers.—ED. M. M.]

MR. CLEMENT'S NAUTICAL INVENTIONS.

*The Sillometer, Marine Thermometer, and Steam Thermometer.*

Since we gave a description of these ingenious instruments, (see *Mech. Mag.*, No. 989, p. 84.,) a very complete series of trials have been made of them, by command of the Lords of the Admiralty, on board of H. M. S. V. *Lightning*, during several voyages from Woolwich to Portsmouth and back, and also up and down the river Medway. We have been favoured with a sight of the Official Reports of these trials, and with permission to make the extracts from them which we subjoin. The results, it will be seen, are in the highest degree satisfactory, and in perfect accordance with those previously obtained by the officers of the French Royal Marine. We may hope, therefore, to see these instruments now generally adopted, both in our government and merchant services; the Marine Thermometer, more especially in all vessels which are exposed to the risk of coming in contact with floating icebergs, or have to navigate unknown, or imperfectly known seas.

1. *Trials with the Sillometer.*

(During Passage from Woolwich to Portsmouth.)

"Thursday, October, 1842.—About one mile and a quarter below Gravesend, commenced a trial between Massey's Patent Log and M. Clement's Sillometer. After a run of $2\frac{1}{2}$ hours, (being off Sheerness,)

Distance given by Massey's Log, $15\frac{1}{10}$ miles.
,, Sillometer .. 15 ,,

"Distance from Nore Light to Deal.
By Sillometer ................ 42 miles
By Tables, reckoning from buoy to buoy.................... $41\frac{1}{4}$

"At 4 h. 25 m. p. m., altered the course 4 points, during which operation the Sillometer showed a diminution of speed, from 8 miles per hour to 7 miles.

"At 8 h. 50 m. p. m., off South Fore-

land, commenced a trial between Massey's Log and the Sillometer. Friday morning. Took in Massey's Log.

"Distance from abreast the South Foreland to about 7 miles to the eastward of the Owers,

By Massey's Log ........... 84¾ miles.
By Sillometer ............. 82½ „
By Tables, reckoning from buoy to buoy ................. 85 „

"Moved sundry weights aft, viz., boat, brass guns, anchor, oars, &c.; for an instant the speed, as shown by the Sillometer, diminished to 7·4 miles per hour, but it almost immediately increased to the former speed of 8 miles.

"Moved the same weights forward: no sensible difference in the speed of the vessel.

"The speed, as shown by the Sillometer, varied from 8·1 to 8·2 miles per hour.

"Tried the speed of the vessel by the common log, which gave ........ 8½ miles
The Sillometer, the same, viz... 8½

"At 10 a. m. About two miles past the Nab Light. Tried Massey's Log.

"Distance to near the entrance of Portsmouth Harbour,

By Massey's Log ........ 6 miles, nearly.
By Sillometer .......... 6 „ exactly.

"During the passage round to Portsmouth, the speed of the vessel was purposely checked, by blowing off steam, to see the effect on the Sillometer. The speed, as shown by the Sillometer, was gradually reduced from 8 miles per hour to 4, at which point it stood steady. On the order being given for full speed, the Sillometer showed a gradual increase of speed, till it came to 8 miles per hour, as before."

On the return voyage, from Portsmouth to Woolwich, the distance performed was,

By Massey's Log ............ 119 miles.
By the Sillometer ............ 118·6

## II. *Trials with the Marine Thermometer.*

(During voyage from Woolwich to Portsmouth.)

| Time of taking Observations. | Marine Thermometer. Centigrade. | |
|---|---|---|
| h. m. | ° | |
| Thursday, 11 0 A. M. | 12·0 | At Woolwich. |
| 12 30 P. M. | 13 55 | |
| 2 25 | 13·55 | |
| 3 25 | 13·25 | 5 Fathom Channel; Cant Shoal; depth of water, about 16 feet. |
| | 13·15 | |
| 3 30 | 13·275 | |
| | 13·5 | About 19 feet depth of water. |
| 3 35 | 13·55 | 3½ fathoms } As called out by the leadsman. |
| 3 40 | 13·575 | 3 „ |
| 3 50 | 13·7 | 3¼ „ |
| 3 55 | 15·25 | 23 feet, as stated by the pilot. |
| 4 0 | 13·7 | 3¼ fathoms } As called out by the leadsman. |
| 4 10 | 13·7 | 3¾ „ |
| 8 30 | 15·0 | |
| 9 30 | 16·0 | Off Dover. |
| Friday, 8 0 A. M. | 16·15 | About 7 miles to the eastward of the Owers. |
| 10 0 | 14·25 | 3 miles from Nab Light. |
| 11 0 | 14·2 | Portsmouth Harbour. |

"It will be seen from the above observations, that at Woolwich the thermometer stood at 12°; as we got into deeper water, it rose to 13·55°; as we approached the Cant Shoal, it fell very rapidly to 13·15°; when off Dover, it had risen to 16°; 7 miles to the eastward of the Owers, it rose to 16·15°; and in Portsmouth Harbour, it fell to 14·2°.

"From which it appears, that the Marine Thermometer, in its variations, followed the inequalities of the bottom of the sea, so far as these inequalities could be ascertained from the heaving of the lead, or from the information of the pilot; that is, on the approach to shoal water, the thermometer fell, and on the approach to deep water, it rose.

"It may be inferred, that the Marin

Thermometer would indicate the approach to rocks and icebergs, from the influence these bodies are known to have on the temperature of the sea, for a considerable distance."

It will be observed, that, when off the Nab Head, the temperature indicated by the Marine Thermometer was 14·25° centig.; but, on the return voyage, the temperature which it indicated off the same point was 16.20 and 16·5, "arising," says the official report, "from the circumstance of our course being *more distant* from the light vessel:" another striking illustration of the correctness with which the instrument denotes the recession from, or approach to, shoal water.

III. *Trials with Steam Thermometer.*

(During passage from Woolwich to Portsmouth.)

| | Temperature of the water just taken from the boilers, as taken by the engineer of the "Lightning." | Height of Steam Gauge. | M. Clement's Steam Thermometer. | |
|---|---|---|---|---|
| | Fahrenheit. | Inches. | Centigrade. | |
| h. m. | ° | | ° | |
| Thursday, 3 0 P.M. | 212 | $2\frac{1}{2}$ | 107·4 | |
| 4 0 | 213 | 4 | 109·5 | |
| 5 0 | $212\frac{1}{2}$ | $3\frac{1}{2}$ | 109·3 | |
| 6 0 | 213 | $3\frac{1}{4}$ | 110·3 | |
| 7 0 | 213 | $3\frac{1}{2}$ | 110·0 | |
| 8 0 | $213\frac{1}{2}$ | 4 | 111·4 | |
| 8 30 | | | 110·7 | Rate of speed by Sillometer, 8·35 miles per hour. |
| Friday, 10 0 A.M. | 214 | $2\frac{1}{2}$ | 107·55 | |
| 11 0 | | | 110·75 | Just bringing up in Portsmouth Harbour. |
| | | | 111·1 | |
| | | | 111·15 | |

We take leave to extract also from the official report the following general observations, in which the merits of the instruments are very impartially and fairly stated.

"The dial of the marine thermometer is on deck, and shows by inspection merely, the approach to shoal and deep water, also, (as it is inferred,) the approach to land, rocks, and ice-bergs.

"The steam thermometer is so placed, that the officer on deck observes the degree of temperature (and pressure) of the steam in the boilers, so that, if from any cause, the temperature of the steam in the boilers becomes higher or lower than it should be, it immediately becomes known; and, in high-pressure engines more especially, the approach to such a degree of temperature and pressure as may be dangerous is easily observed.

"The sillometer has also a dial upon deck, which constantly shows the number of miles per hour that the vessel is going; consequently, it is easy to discover, under all circumstances, what is the best trim of the vessel, and the most advantageous quantity and distribution of the sails, for obtaining the greatest speed. As the sillometer shows immediately, the effect which every alteration in the sails or trim of the ship has on its velocity, it follows also, that ships fitted with the sillometer can constantly maintain the speed that may have been agreed upon, and so keep company together, and maintain the same relative position, though, from the darkness of the night, or thickness of the weather, they cannot see each other.

"To ascertain the distance run after any number of hours, it is simply to take the number of minutes one of the watches of the sillometer has gained over the other, and to multiply that number by 6, there results the distance run in miles.

"The instruments of Monsr. Clement, fitted on board the *Lightning*, appear to be well and securely placed; nor does there appear to be any danger of their being deranged."

We subjoin the account of the additional trials made with the thermometer in the Medway.

*Trials with the Steam Thermometer in the Medway.*

| Oct. 16, 1842. | Centigrade. | |
|---|---|---|
| h. m. | | |
| 12 40 P.M. | | Sheerness. |
| 1 45 | | Upnor |
| 2 0 | 111·3 | Off Chatham dock |
| | 111·3 | Vessel stopped |
| | 111·5 | |
| | | Ordered to go on. |
| | 110·2 | |
| | 110·1 | |
| | 109·95 | |
| | 109·8 | |
| | 109·7 | |
| | 109.6 | |
| | 109·4 | |
| | 109·3 | |
| | | Order to ease her. a little. |
| | 109·7 | |
| | 109·8 | |
| | 109·9 | |
| | 110·0 | |
| | 110·1 | |
| | 110·2 | |
| | 110·3 | |
| | 110·4 | |
| | 110·5 | |
| | 110·9 | |
| | | Order, "go on." |
| | 110 8 | |
| 4 0 | 110·75 | Abreast Upnor. |
| | 110·7 | |
| | 110·4 | |
| | 110·15 | Off Gillingham. |
| 4 10 | 110·1 | |
| | | Order to ease her. |
| | 110·15 | |
| 4 15 | 110 20 | |
| | 110 5 | |
| | 110·2 | Going full speed |
| | 110·1 | |
| | 110·0 | |
| | 109·8 | |
| 4 20 | 109·2 | |
| 4 25 | 108·1 | |
| | 108·0 | |
| | 107·5 | |
| 4 30 | 107·0 | |
| | 106·9 | |
| | 107·5 | Arrived at Sheerness. |
| 4 40 | 108·3 | |

The observations here taken show how every variation in the temperature of the steam in the boilers is indicated by the steam thermometer of Monsr. Clement. Thus, when the vessel was stopped, the temperature of the steam was 111°·5 (centigrade); on getting under weigh, it lowered to 109°·3; going easy, it rose to 110·9; going on again, it lowered to 110°·1: going easy again, it rose to 110·5; going on at full speed, it gradually lowered to 106°·9.

ABSTRACTS OF SPECIFICATIONS OF ENGLISH PATENTS RECENTLY ENROLLED.

Charles Hancock, of Grosvenor-place, Artist, *for certain improvements in printing cotton, silk, woollen, and other stuffs.* Patent dated February 8, 1842.

These improvements consist in printing cotton, silk, woollen, and other stuffs, with oil or oil-colours, without any previous preparation of the stuffs by mordants, sizes, or otherwise; and also in printing them partly with oil or oil-colours, and partly with water-colours or dischargeable resists, whereby the ordinary process of printing is greatly abridged. The following is given as "the manner in which the said improvements are to be performed."

"To obtain a suitable medium for the colours, I first mix linseed-oil, nut-oil, or other drying oil, (preferring linseed-oil, because of its drying quality, and of its retaining its fluidity at lower temperatures than most others,) and raw or burnt Turkey umber together, in the proportion of about one gallon of the oil for about every pound of the umber; and I boil this mixture over a slow fire, in an open metal pan of large area, and of sufficient depth to allow it to rise without boiling over, continuing the boiling until the mixture gives indication of having nearly parted with most of its evaporable constituents, and taking care to draw the fire before any deposition of carbon takes place, which would have a discolouring effect on the contents of the pan. When these conditions have been duly observed, the resulting product is a viscid substance, of an uniform consistency, resembling that of dissolved caoutchouc, flowing freely on the application of a slight heat, or spreading by slight mechanical pressure, and neither soiling nor running, on being brought into contact with textile fabrics or paper. Instead of completing the process at one boiling, it may be effected with less risk of failure, though more slowly, by several boilings, allowing the mixture or the oil to cool each time the fire is drawn. A metal cover may be suspended over the pan by weighted chains, or ropes passing over pulleys, so that, in the event of the inflammable gases disengaged catching fire, the cover may be instantly lowered, and the flame extinguished. When it is desirable, for any particular purpose, to have the medium of a more drying or more adhesive quality than usual, I add, as the

case may be, to the mixture or oil, when in the pan, either a little white vitriol, litharge, sugar of lead, or other drier, or a little of any suitable resin. Before the product of the boiling or boilings has become quite cold, it may be thinned down, if desired, with highly-rectified oil of turpentine, or any other sufficient solvent. In order to combine the composition or medium, the nature and preparation of which I have thus described, with any of the pigments or other matters suitable for the printing of cotton, silk, woollen, and other stuffs, the combination is best effected in vessels heated by steam, according to the mode usually adopted in colour manufactories and laboratories. When the colours are to be applied to the stuffs, it may be done without any previous preparation of the stuffs by mordants, sizes, oils, or otherwise, and by means either of cylinder printing-machines, or plates, or blocks. If the medium has been previously thinned sufficiently by oil of turpentine, or other solvent, the colours may be applied in a cold state; or, if the medium has not been so previously thinned, then, in order to make the colours flow freely, the colour-troughs, tearing-sieves, plates, and cylinders must be kept warm by steam, or some other transmitter of a gentle heat, by any of the well-known methods commonly employed for such purposes. The colours do not rest on the surface, but penetrate the body of the stuff, and this without running. Any smell imparted by the oil or turpentine may be dissipated by exposure to the air. The stuffs so printed on may be of any colour or colours."

In the processes hitherto described, it has been supposed that the figures, designs, or patterns, are to be printed with the oil-colours, but instead thereof the figures, designs, or patterns may be produced in the manner of resists, by some fugitive water-colour, gum, or paste, and an oil-colour, prepared as before directed, be made use of to produce only the general ground, the stuff being washed afterwards to discharge the resist, and then aired, as before directed, to get rid of any smell of the oil or turpentine.

THOMAS CLIVE, OF BIRMINGHAM, *for certain improvements in the construction of candlesticks.* Patent, dated April 7, 1842.

These improvements in candlesticks consist firstly, in the construction of a new apparatus or "push up" (as this part is commonly called) for raising the candle in the socket of the candlestick, and secondly, in the combination of this "new push up" with an elastic holder for holding a candle securely in the candlestick, and for which (in part) a patent was granted 25th April, 1839, to James Barlow, of Birmingham.

The new "push up" is composed of a brass rack and pinion. The rack is about one sixteenth part of an inch thick, and forms an arc of about two-fifths of a circle, (except at its top and bottom ends which are complete circles,) and upon the edges of this arc, a number of teeth are cut, into which the pinion is geared. The (circular) top of this arc has a flat circular disc of metal soldered into it, and forms a base to which the cup for the candle is riveted, and in the back of this arc a spring is made by cutting away the metal from three of its sides, (leaving it suspended at the top), and then pressing it outward. The use of this spring is by pressing against the shaft of the candlestick, to prevent the rack or "push up" sliding downwards, except when actuated upon by the pinion. The rack or "push up" being now put in the shaft, the pinion is put through a hole made in each side of the shaft upon which it is supported, and it is fastened in its place by being riveted at the end. By turning round a knob with the fore-finger and thumb, the pinion revolves and moves the rack or "push up" either up or down, depending upon the way in which the knob is turned.

The "claim" is to any "push up, in which a rack and pinion is used, of whatever form and however placed," and also to the method before described as well as several others stated in the specification of "giving motion to the rack and pinion."

JOHN GEORGE BODMER, OF MANCHESTER, *for certain improvements in machinery or apparatus for cleaning, carding, roving, or spinning, cotton and other fibrous substances.* Patent dated March 7, 1842.

The present improvements have reference principally to certain machines formerly patented by Mr. Bodmer, and particularly to those which were the subject of the patent of October 23, 1836.

The patentee describes, 1. An improved blower and lap-frame, by means of which he can form one single narrow lap, say of 5 inches in width, from the produce of a beater and feeding apparatus, "of the usual or any convenient width."

2. A self-acting tool or doffer, by which the sliver, or lap of a lap-frame, is cut, instead of being separated as usual by hand.

3. An "improved mechanism" for clearing, shifting, or stripping flats or top-cards. This improvement, the patentee says, he considers "of great importance, because of the simplicity and strength of the mechanism, and the improved position of the stripping-rollers, as the fibres which hang down from the cards are in a more favourable position to be taken hold of by the rollers, which may be driven by straps and pullies, or by gearing from any of the slow moving rollers of the carding-engine."

4. Some improvements in the steam cylinder clearer, consisting chiefly of a number of narrow brushes, instead of one.

5. An improved method of grinding the wire of card-cylinders, flats, &c.; that is, of keeping the wires constantly sharp and fine.

6. An improved mode of feeding the carding-engine, with the laps supplied by the improved blower and lap-frame (No. 1); the object of which is to correct the inequality ordinarily arising from the irregular spreading of the cotton at the lap-machine, by reducing the width of the cotton as spread.

7. An improved twist coil frame, the main feature of novelty in which is a change in the direction of the roving, which in the machine described forms the coil from *below*.

8. An improvement in the capping motion of the spinning-frame.

9. A new mode of banding or driving the spindles.

10. An improved flyer made of buffalo hide, softened in water, and bent in a mould.

And 11. Another flyer, made of two pieces of whalebone with wire bent round them, which wire again has thread wound round it, for the double purpose of securing the whalebone between the wires, and protecting the wires from rubbing against the iron or steel guide-plate.

JOHN LAMB, OF KIDDERMINSTER, MACHINIST, *for "certain improvements in engines to be worked by steam, air, gas, or vapours; which improvements are also applicable to pumps for raising or forcing water, air, and other fluids."* Patent dated April 15, 1842.

The improvements which are the subject of this patent relate exclusively to the class of rotary engines, and are stated to "consist in one cylinder working inside another in a peculiar manner." The "manner" is ingenious, as well as "peculiar," but could not be explained satisfactorily without the aid of some of the eighteen drawings with which it has been found necessary to accompany the specification. Some general idea of the inventor's mode of action may be gathered from his claim, which is for "firstly, the application of an eccentric cylinder or cylinders, in combination with a stationary stop or stops; such cylinders being capable of turning on their own axes, and performing the motions required of them;" and secondly, for "a like arrangement of apparatus for the purpose of raising or forcing water, air, or other fluids."

## LIST OF ENGLISH PATENTS GRANTED BETWEEN THE 29TH OF SEPTEMBER, 1842, AND THE 27TH OF OCTOBER, 1842.

Edward Bell, of the College of Civil Engineers, Putney, professor of practical mechanics, for improvements in applying heat in the manufacture of artificial fuel, which improvements are applicable to the preparation of asphalt, and for other purposes. September 29; six months.

Samuel Henson, of New City Chambers, Bishopsgate-street, engineer, for certain improvements in locomotive apparatus, and in machinery for conveying letters, goods, and passengers, from place to place through the air, part of which improvements are applicable to locomotive, and other machinery to be used on water or on land. September 29; six months.

William Smith, of Grosvenor-street, Camberwell, gentleman, for improvements in treating certain animal matters, to obtain products applicable to the manufacture of candles, and other purposes. September 29; six months.

John Rand, of Howland-street, Fitzroy-square, artist, for improvements in making and closing metallic collapsable vessels. September 29; six months.

James Hyde, of Duckenfield, Cheshire, machine-maker, and John Hyde of the same place, cotton-spinner, and manufacturer, for a certain improvement or improvements in the machinery used for preparing cotton, wool, silk, flax, and similar fibrous materials for spinning. September 29; six months.

John Ridsdale, of Leeds, for improvements in preparing fibrous materials for weaving, and in sizing warps. September 29; six months.

John Fry Wilkey, of Mount Vernon, Exeter, commission agent, for improvements in carriages. September 29; six months.

John George Shipley, of Bruton-street, Berkeley-square, saddler, for certain improvements in saddles. October 6; six months.

John Oliver York, of Upper Coleshill street, Eaton-square, for improvements in the manufacture of axles for railway wheels. October 8; six months.

Wilton George Turner, of Gateshead, Durham, doctor in philosophy, for improvements in the manufacture of alum. October 8; six months.

Claude Edward Deutsche, of Fricour's Hotel, St. Martin's-lane, gentleman, for improvements in combining materials to be used for cementing purposes, and for preventing the passage of fluids, and also for forming or constructing articles from such compositions of materials. October 8; six months.

Samuel Dotchin, of Myrtle-street, Hoxton, jeweller, for improvements in paving, or covering, and constructing roads, ways, and other surfaces. (Being a communication from his son lately deceased.) October 13; six months.

William Edward Newton, of Chancery-lane, patent agent, for certain improvements in the manufacture of artificial fuel. (Being a communication) October 13; six months.

Charles Thomas Holcombe, of Valentines, near Ilford, Essex, Esq., for an improved mode of using certain materials as fuel; also an apparatus or method for collecting the smoke or soot arising from the combustion of such fuel; which apparatus or method is applicable to collecting the smoke or soot arising from the ordinary combustion of fuel, and also the application of the products arising from the combustion of the first mentioned materials, as a manure, and for other useful purposes.—Six months; October 13.

Robert William Sievier, of Henrietta-street, Cavendish-square, gentleman, for certain improvements in looms for weaving, and in the mode or method of producing plain or figured goods or fabrics.—Six months; October 13.

Peter Kagenbusch, of Lyth, in the county of York, dyer, for certain improvements in the treatment of the alum rock, or schist, and in the manufacture and application of the products derived therefrom. —Six months; October 13.

Henry Brown, of Selkirk, manufacturer, and Thomas Walker, of the same place, manufacturer, for improvements on woollen carding engines. Six months; October 13.

Thomas Seville, of Royton, Lancaster, cotton

spinner, for certain improvements in machinery used in the preparing and spinning of cotton, flax, and other fibrous substances. Six months; October 20.

James Palmer Budd, of Ystalyfera Iron Works, Swansea, merchant, for improvements in the manufacture of iron. Six months; October 20.

William Longmaid, of Plymouth, accountant, for improvements in treating ores and other minerals, and in obtaining various products therefrom, certain parts of which improvements are applicable to the manufacture of alkali. Six months; October 20.

James Statham, of West-street, St. Giles's, Venetian lock maker, for improvements in the construction of locks, for Venetian blinds used in carriages. Six months; October 20.

Gilbert Claude Alzard, of Tichborne-street, gent., for certain improvements in bread, biscuits, macaroni, vermicelli, and pastry, and the mode of making the same. Six months; October 20.

George Hazeldine, of Lant-street, Southwark, coach manufacturer, for certain improvements in omnibuses. Six months; October 27.

James Gardner, of Banbury, ironmonger, for improvements in cutting hay, straw, and other vegetable matters for the food of animals. Six months; October 27.

John Mullins, of Battersea, surgeon, for improvements in making oxides of metals in separating silver and other metals from their compounds, with other metals, and in making white lead, sugar of lead, and other salts of lead, and salts of other metals. Six months; October 27.

Rowland Williams, of Manchester, fustian shearer, for certain improvements in machinery, or apparatus for raising, shearing, and finishing velvets, or other piled goods by power. Six months; October 27.

## LIST OF PATENTS GRANTED FOR SCOTLAND FROM 22ND OF SEPTEMBER TO 22ND OF OCTOBER, 1842.

Charles William Firchild, of Wesley Park, Norfield, Worcester, farmer, for an improved propelling apparatus for marine and other purposes. Sealed September 26, 1842.

Edwin Ward Trent, of Old Ford, Bow, Middlesex, rope maker, for an improved mode of preparing oakum and other fibrous substances, for caulking ships and other vessels. September 29.

Peter Hagenbusch, of Wetter, on Rhur, in Westphalia, in the kingdom of Prussia, dyer, and now residing in the parish of Lyth, in the county of York, in England, for certain improvements in the treatment of the alum rock, or schist, and in the manufacture and application of the products derived therefrom. September 29.

Henry Bewley, of Dublin, in the county of the city of Dublin, licentiate apothecary and chemist, for an improved chalybeate water. October 4.

Alfred Jeffrey, of Lloyd's-street, Pentonville, Middlesex, gentleman, for a new method of preparing masts, spars, and other wood for ship building and other purposes. October 18.

Claude Edward Deutsche, of Fricours Hotel, St. Martin's Lane, Middlesex, gentleman, for improvements in combining materials to be used for cementing purposes, and for the preventing the passage of fluids, and also for forming articles from such composition of materials. (Being a communication.) October 18.

John Ridsdale, of Leeds, York, for improvements in preparing fibrous materials for weaving, and in sizing warps. October 20.

Samuel Carson, of York-street, Covent Garden, Middlesex, gentleman, for improvements in purifying and preserving animal substances. Oct. 20.

Henry Brown, of Selkirk, manufacturer, and Thomas Walker, of the same place, manufacturer, for improvements on woollen carding engines. October 20.

Alphonse de Thirsbrioux, of Great Russel-street, Bloomsbury, Middlesex, gentleman, for improvements in lithographic and other printing presses. October 20.

*The Manufacture of Watches.*—A select committee of the House of Commons sat upon this subject in the year 1818, and it appears from the report that in 1796 the number of gold and silver watch cases marked in Goldsmiths'-hall amounted to 191,678; while in the year 1816 the gradual reduction had brought that number down to 102,112, exhibiting a diminution of 89,566, or nearly one-half; and it further appears from the last edition of M'Culloch's *Dictionary of Commerce*, that that number was reduced in 1841 to less than 100,000. In one township alone, in Lancashire, called Prescott, in which the manufacture of the movements of watches was the staple, there were in 1821, 869 families employed in handicrafts, whilst in 1831, from the manufacture of watches being utterly destroyed, that number was reduced to only 540. That which this country has lost, Switzerland has chiefly gained; and it is proved that England is, in this respect, tributary to the Continent—that every year the quantity of foreign watches sold in London and in the principal towns of the three kingdoms, is more than ten-fold the amount of those manufactured in England. This great injury to our manufactures and loss to our trade is likely speedily to have an end; a gentleman, who has devoted 20 years of his life to this subject, having made a variety of machines by which an incredible number of watches, of every variety of size, may be made in a day. By one of the machines 300 perfect plates can be produced in a day, by another the same quantity of barrels; by five machines the requisite number of centre, third, and fourth wheels (crossed, polished, and cut) with balances for 300 movements. By another 200 pinions can be cut and rounded; by another the holes are drilled, the tapping, the screw-holes, the various parts in the plate are sunk, planting the depths and escapement, &c., and all with such exactness as cannot be excelled; another for the making and polishing of pivots, &c. Four other machines will be sufficient for making pivots for 50 movements a-day; and to add to these, there are 20 other machines for every description of work connected with the watch-making, and which altogether constitute a set. The inventor has submitted these machines to the scrutinising inspection of the most experienced makers of chronometers and watches in London, and not one has expressed a doubt of the work so produced being incomparably superior to that done in the usual way. Among other distinguished names in the trade we have observed those of Mr. Barwise, Mr. Earnshaw, Mr. Hewett, Mr. Vieyres, Messrs. Frodsham and Co., with about a hundred watchmakers in the country, who, with the Duke of Hamilton and Mr. Howell (of the firm of Howell and James) at their head, are engaged in carrying out the great and national object of restoring this lost and important manufacture to England by means that while they greatly lessen the price, will improve the quality, and entirely undersell our foreign rivals, and be very largely profitable to all parties concerned.—*Standard.*



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## MESSRS. WHITELAW AND STIRRAT'S HYDRAULIC ROTARY ENGINES—LATEST IMPROVEMENTS.

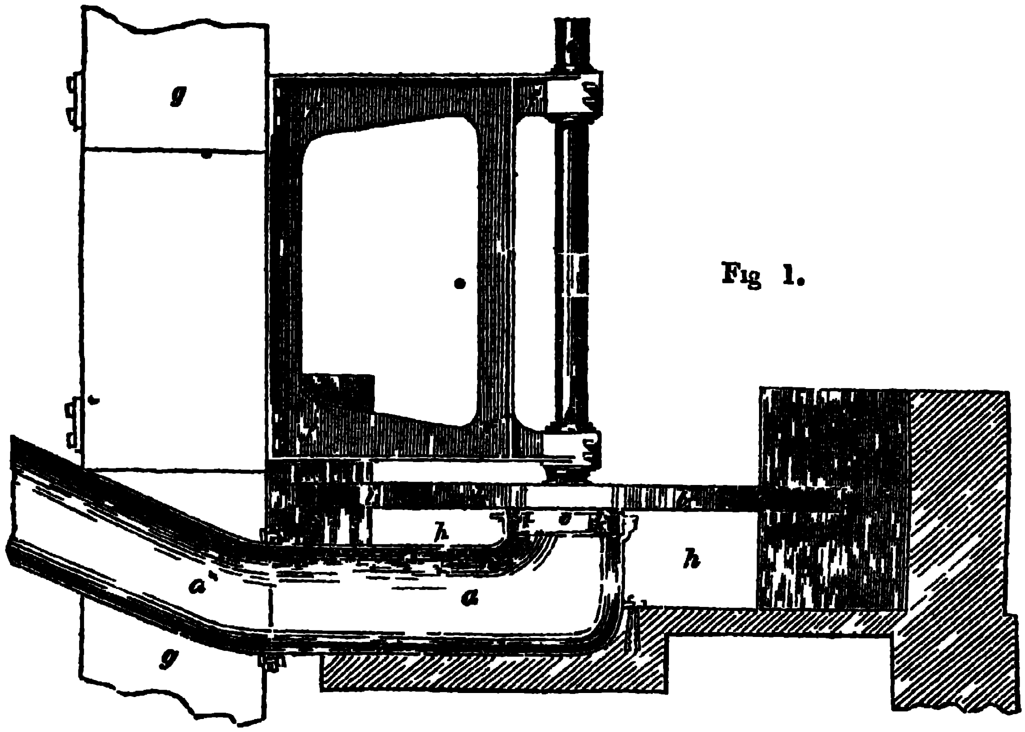
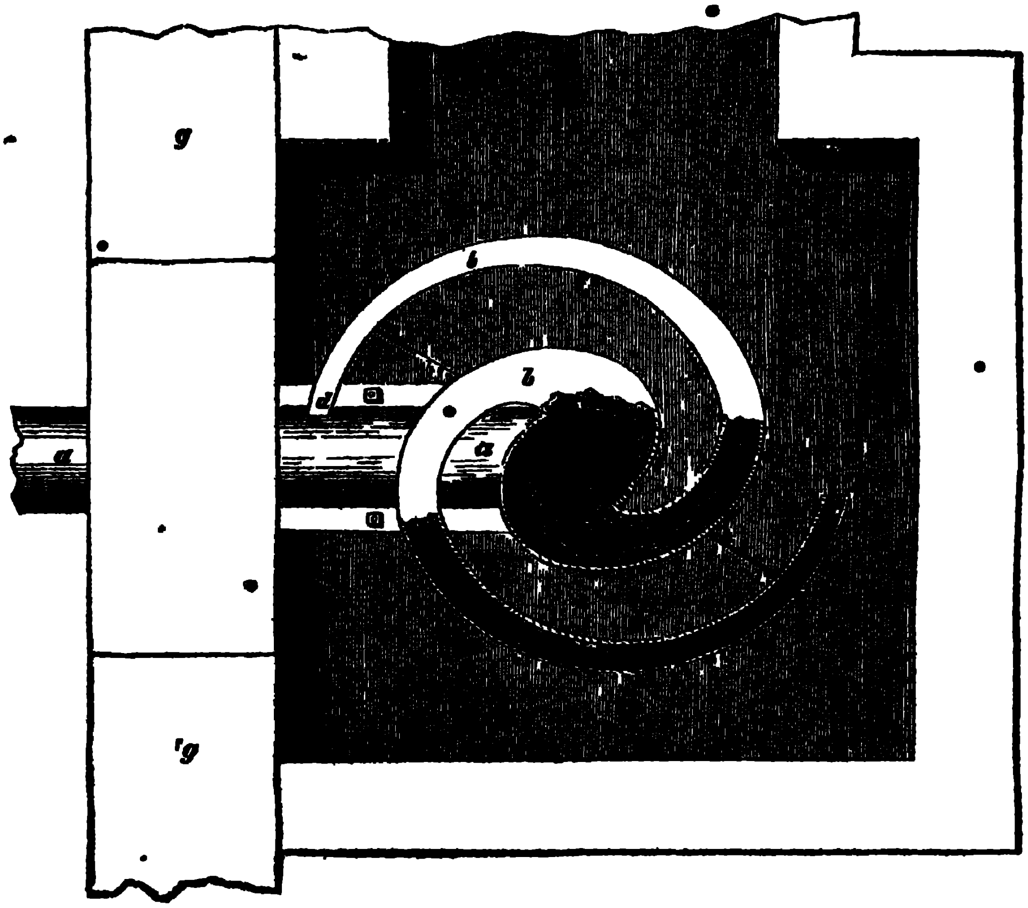



Fig 1.

Fig 2.



## MESSRS. WHITELAW AND STIRRAT'S HYDRAULIC ROTARY ENGINES—LATEST IMPROVEMENTS.

We described about two years ago (see *Mech. Mag.* No. 903,) the hydraulic rotary engine originally patented by Mr. James Whitelaw, of Glasgow, and which has since obtained so much celebrity in the mechanical world; and we have now to lay before our readers a description of some important improvements which have been since invented and patented by the same gentleman in conjunction with Mr. James Stirrat of Paisley.

Figs. 1 and 2 of the accompanying engravings represent an elevation and plan of the original engine in its present most improved state. The engine, it will be recollected, is worked by the pressure and reaction of a column of water. The main pipe *a a*, conducts the water which drives the machine into its arms from a reservoir or head on a higher level than the arms; *b b b b* are the arms which are hollow; the water passes into them at the centre part *c*, and escapes out at the jet pipes *d d*. The motion of the arms is communicated to *e e*, the main, or driving shaft of the machine, and by means of a wheel, pinion or pully, fixed on the shaft *e e*, its rotary motion may be communicated to any machinery which the water mill may be intended to work; *f f f f* is a large bracket, which is fixed to the wall, or building, *g g*; this bracket supports the shaft *e e*. The tail race is marked *h h*. As the arms have a rotary motion, and the pipe *a a* is fixed to the building under it, there must be means provided to prevent the escape of water at the place where the main pipe meets the arms. A contrivance suitable for this purpose is shown in fig. 1. It consists of a ring *i i*, round the underside of *c*, the central opening or aperture leading into the arms, and of a part *k k*, turned cylindrical at the place where it fits into the bored part on the top of the pipe *a a*. The part *k k* has a groove turned round its outside, near to its bottom end. The groove is to be wrapped full of soft twine, in order to prevent the escape of water betwixt the pipe and the cylindrical part of *k k*. There is a flanch outside of the part *k k*, and rope yarn is wrapped round in the space betwixt this flanch and the top of the main pipe, for the purpose of keeping the top of *k k* in contact with the bottom of the ring *i i*. It will be clear, that if the ring *i i* and the part *k k* be accurately turned and ground upon each other at the place where they meet, the rope yarn in the space betwixt the flanch outside of *k k*, and the top of the main pipe will press the part *k k* in contact with the ring *i i*, and in this way keep the joining of these parts water-tight; *l l l l* are ribs or stays, which support the arms.

The mode of fixing the arms of the machine is thus described:—

"Let 1, 4, 9, (fig. 3) be a circle of the same diameter as that described by the centre of the jet pipes, and let this circle be divided into, say twelve equal parts, in the points 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, and let the radius 1 *w* be also divided into twelve equal parts in the points *a c e g i k m o q s* and *u*. From each division on the circle draw a straight line to the centre *w*, and from the division at *a*, on the radius, draw from the centre *w* a portion of a circle till it cuts the radius 2 *w* in the point *b*. From the same centre *w* draw a portion of a circle through the second point *c*, till it cuts the radius 3 *w* in the point *d*. In this way continue to draw concentric arcs from the divisions on the radius 1 *w*, making each concentric arc to terminate in that radius immediately following the radius in which the arc formerly drawn was made to terminate. The points of intersection 1 *b*, *d*, *f*, *h*, *j*, *l*, *n*, *p*, *r*, *t*, *u*, and *w*, thus obtained, will be points in the middle of the breadth of the arm, and a curved line traced through these points will be the curve of the middle of the breadth of the arm. After the curved line 1 *d*, *l*, *r*, *w*, is formed, any number of points in the curve lines, which form the sides of the arm, will be obtained in the following way. With *w* as a centre draw such a number of concentric circular arcs passing through the curve line 1 *d*, *l*, *r*, *w*, as may give a sufficient number of the required points. Then, with a pair of compasses take a distance equal to four times the width of the outer end of the jet pipe, and set off that distance upon each such concentric arc, twice measuring, once upon each side of the curve 1 *d*, *l*, *r*, *w*, from the point of intersection of the arc and that curve. The points marked off on one side of the curve line 1 *d*, *l*, *r*, *w*, are points in one side of the arm, and the points similarly marked off on the other side of that curve are points in the curve which form the other side of the arm;

and the curves drawn, or traced through these points, are the curves forming the sides of the arm. Thus, the breadth of the arm opposite the centre point *v* is found by drawing the circular arc *x* through this point, and measuring off from *v* to *x* on the one side of the curve line running through the middle of the arm, and from *v* to the opposite point

Fig. 3.

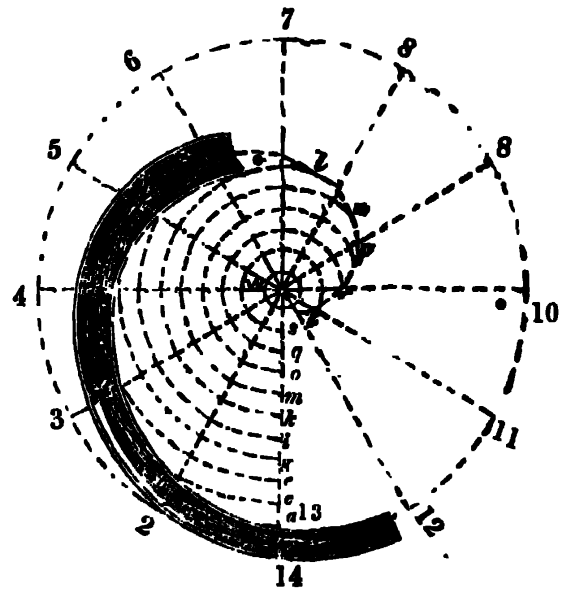


Fig. 6.

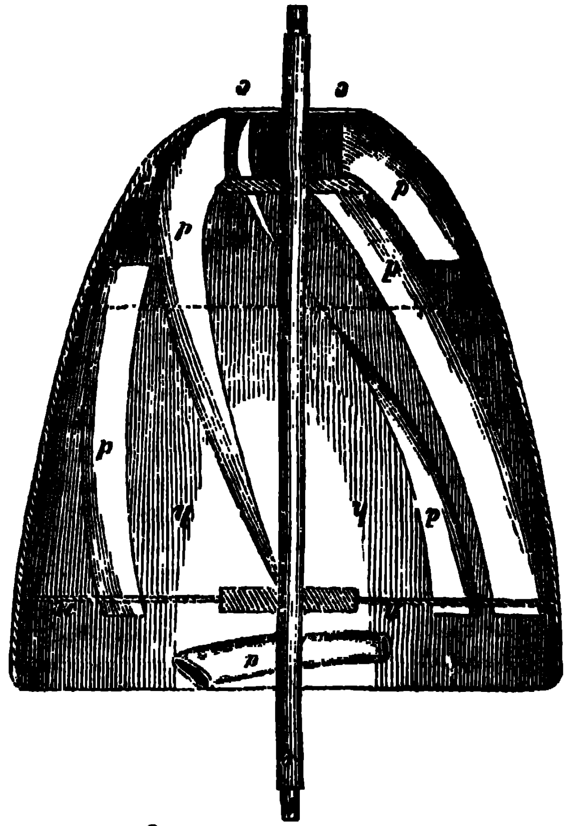


Fig. 4.

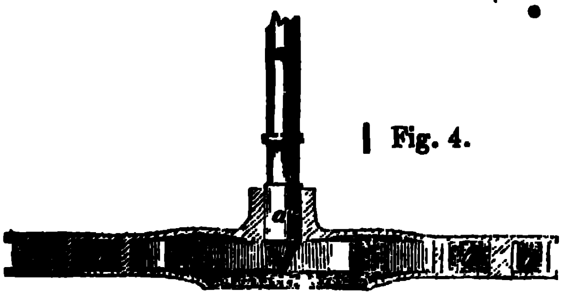


Fig. 5.

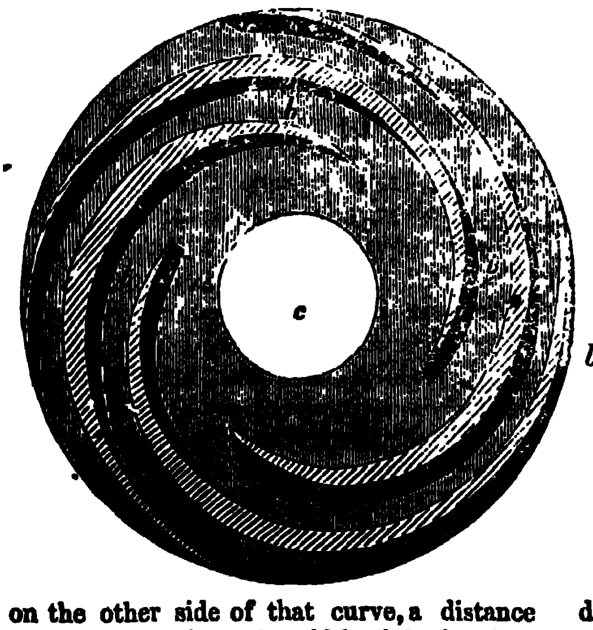


Fig. 7.

on the other side of that curve, a distance equal to four times the width of the jet pipe, and in the same way the breadth of the arm at any other point will be found. If the arm be drawn in the manner now described, its depth, as also that of its jet piece, will be uniform throughout.

In fig. 1, the depth of the arms and jet

pieces are thus adjusted. The width of each jet pipe being, as before mentioned, one-fourth of the length of the chord subtending the circular arcs which determine the width of the arm, if one-eighth of this chord be set off on each side of the circle 1, 4, 9, and a portion of a circle having *w* for its centre, be drawn from the outer end of the arm through each point so set off, and towards 12, it will coincide with the outer and inner sides of the jet pipe. In practice, the corners 13 and 14 (fig. 3) should be rounded off in the manner shown in fig. 2.

"In cases where the machine moves so fast as not to allow time for the water leaving it to fall a distance equal to the depth of the arm, before the next arm comes up, the water which leaves the one arm will be struck by the other, and thus the machine will be in some measure retarded. When the machine moves at a speed slower than that of the water, this defect may, in most cases, be remedied by simply turning the outer extremity of the jet pipes a little outwards, in order that the water which leaves the one arm may be thrown outside the other. The width of the jet pipes in relation to that of the arms will be regulated by the velocity of the machine in relation to that of the water which works it. Thus, if the machine moves at the same speed as the water, the width of the outer end of each jet piece should be about one-third of the length of the chord subtending the arcs, which determine the breadth of the arm. The machine which we have just described should move at a speed about one-third slower than that of the water, and if the machine moves at about three-fourths of the speed of the water, the chord which subtends the arcs which determine the breadth of the arm should be two and a half times longer than the width of the jet pipe."

The advantage of the present machine over that first invented by Mr. Whitelaw consists in its preventing more effectually the water from being carried round with the arms. Of this the patentees give the following very clear and satisfactory explanation:—

"Suppose, for the sake of illustration, that the centre of the jet-pipes move at a speed as great as that of the water issuing from them. In this case, the width of each jet-pipe will be about one-sixth of the width of the arm, its width being marked off on circular arcs, in the manner before mentioned. An arm of the kind represented in fig. 3, if its dimensions be as last given, will contain about as much water as will fill a straight arm running from the centre out to the jet-pipe, if the area of the cross section of the straight arm be uniform throughout its length, and this area be six times larger than that of the jet-pipe. A straight arm having its cross sectional area six times larger than its jet-pipe will, in one revolution, expend about as much water as will fill the arm, the motion of the water through the arm being six times slower than its speed through the jet-pipe, and the radius of a circle being to its circumference nearly as one to six, the length of the arm being to the circumference described by its jet-pipe in the same proportion. But the capacity of the curved arm being the same as that of the straight arm, as much water as will fill the former will be the quantity required during one revolution of the machine. From this it is clear, that the water which is leaving the centre, *w*, at any instant when the arm is in the position shown in fig. 3, will, after the arm has made one revolution, be out at 1, the beginning of the jet-pipe. The cross sectional areas of the arm are so adapted to the curvature of the line 1 *d l r w*, that whenever any point, as *p*, in the arm, arrives at the point *o*, in the radius *w* 1, the water which left the centre when the arm was in the position shown in the figure, will also have arrived at or near the point *o*, and thus the water will flow from the centre of the machine out to the jet-piece in a straight line, or nearly so, when the machine is in motion."

When a jet-pipe moves at a speed slower than that of the water issuing from it, the arm may have a greater capacity than it would have if the motion of the jet-pipe were as great as that of the water without carrying the water round with it; for when the speed of the arm is reduced, the speed of the water flowing through it may also be diminished. The kind of arm shown in figs. 1, 2, and 3 has an uniform depth throughout its length, and its cross section at any point is of a rectangular form; but it will be evident that each cross section of an arm and jet-pipe may be of a square, circular, or any other suitable form, provided the square, circular, or other form of arm has its cross sectional areas at the corresponding distances from the centre *w*, the same as the cross sectional areas of the kind of arm shown in figs. 1, 2, and 3.

For working in tail water, the patentees recommend such a modification of the machine, figs. 1 and 2, as is represented in figs. 4 and 5. Here two circular plates are set apart from each other, at a distance equal to the depth of the arms,

with curved division pieces to form the sides of the arms, and jet-pieces fixed betwixt the plates; the main shaft is fastened to the centre of the uppermost plate, and the opening for the water is in the centre of the plate which is undermost. If the arms or water spaces are beyond a certain width, the inner ends of the divisions placed betwixt the plates, will terminate in a sharp end before they reach the central opening. Betwixt the inner ends of the division pieces and the central opening, the top and bottom plates should be formed, in such a manner as to allow the water to flow from this opening out to the inner ends of the arms, at every point of its passage, with the same, or nearly the same degree of speed. This is managed by diminishing, from the central opening out to the inner end of the arms, the depth of the space which is betwixt the top and bottom plates. *a a* is part of the main shaft; the arms or passages for the water are marked *b b*; and *c* is the central opening for the water.

Another machine, differing more materially from the first, is represented in figs. 6 and 7.

In this machine the main pipe, *a a*, conducts the water from the reservoir *b b; c c* is the rotary part of the machine; this part is open at the top end, *b b*, where the water is admitted, and it has an opening at *c c*, its bottom end, to allow the water to escape after it has acted on the machine. To the inside of *b b*, *c c*, the plates or blades marked *d d* are fixed. These plates run from near the top of *b b*, *c c*, to the opening below, in a spiral direction, as shown in the figures. The main shaft or spindle, *e e*, is fixed to the blades, and to the part *b b*, *c c*, in the manner shown in fig. 7, in order that the motion which will be given to the part *b b*, *c c*, by the action of the water on the blades, may be communicated to the shaft *e e*. The bottom end, or foot, *f*, of the shaft turns in brasses, in the ordinary way, and its top end has a bearing at *g*. It will now be clear, that if the water be allowed to rush from the main pipe *a a* into the part *b b*, *c c*, it will, by its force against the blades, set them, and the parts in connexion with them, in motion; but the weight of the water will, during its descent along the spaces marked *h h*, also act upon the upper inclined surfaces of the blades *d d*, and assist in keeping up the motion of the machine. Thus, one part of the force which keeps the machine in motion is derived from the momentum given to the water by the pressure of the column of water which is above the under end of the main pipe, and another part of this force is obtained by the weight of the water after it gets into the part *b b*, *c c*.

The hydraulic engine we have last described is an improvement on the well-known machine called the "Danaide;" the principal difference in the two machines is, that, in the "Danaide," the plates or blades which the water acts against are straight, and have a vertical position, while, in the new machine, the blades run from near its top end to the opening below, in an angular or spiral direction.

### ON THE MOTION OF A FALLING ARROW OR DART. BY CAPTAIN J. NORTON.

Sir,—It has frequently occurred to me, when a school-boy, practising with an arrow or dart of a peculiar form, that the arrow, in descending, after being thrown or shot perpendicularly into the air, instead of coming down with its point foremost, has turned on its side, and come to the ground spinning horizontally, so as to resemble the wheel of a jack. The arrow, which in its ordinary fall would reach the ground in the space of a second, by this rotary motion in a horizontal line occupies full a minute in its descent. I mention this fact in the hope that some of your numerous readers may be so good as to explain the cause, as, in the event of the art of flying ever coming into fashion, a knowledge of the cause of the arrow performing the horizontal motions of a wheel may be of practical use. The arrow I allude to was in the form of a flat spoon, having a notch about its centre, where it was found to balance, inclining towards its point, and was cast by means of a pliable stick, having a string at the end of it; a knot in the string fitted into the notch, and by bending the stick the arrow was discharged.

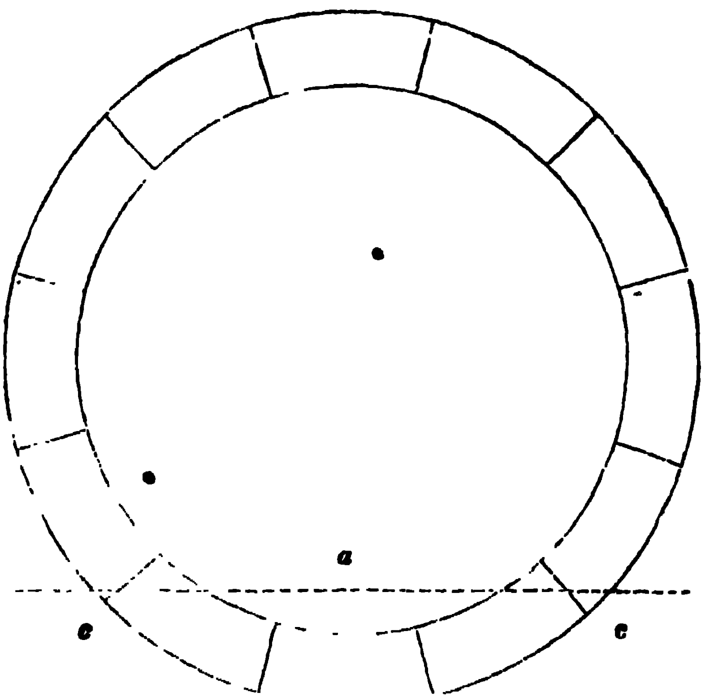
Yours, &c.,
J. NORTON.

## MR. ZANDER'S TABLES OF THE SIX STEAMERS PLYING ABOVE BRIDGE.

Sir,—The interesting notice of Mr. Zander's steam expansion and condensing systems in the two last Numbers of your valuable journal is accompanied by two useful comparative tables of the dimensions and performances of sundry steam-boats; but in those tables there appears to me to be an error with regard to the *area* of the total effective paddle-board surface of each vessel, which, should my view be incorrect, I hope will call forth a reply from some of your able correspondents.

I will take, for instance, the dimensions given of the *Era's* paddles—length of the boards 5 feet, breadth 1 foot; number in each wheel 12; number of paddle boards immersed in the water in both wheels 5. Area of paddle-boards in both wheels, or total *effective paddle surface 25 square feet.* Now, it is to this statement, that *the effective paddle surface is equal to the area of all the floats immersed*, that I wish to invite attention.

With paddle-wheels of the foregoing dimensions, in order that 2½ floats in each wheel may be immersed, the dotted line of the accompanying figure must be




the water line, cutting the floats *c c* at one-fourth their breadth, in which case the greatest depth of immersion, *a b*, would not exceed 1 foot 8 or 9 inches, which, multiplied by the breadth of the wheel (5 feet) gives an area of effective paddle-board surface for each wheel of 8¾ square feet, or 17½ feet for both wheels, instead of 25 feet; for I cannot conceive that the boards immersed and moving behind each other so rapidly exactly in the same plane, increase the area of resisting surface which each presents, but merely maintain a constant action upon that area, as each board rises out of the water in succession.

But I very much question whether the mean useful effect extends beyond the area of one paddle board in each wheel (or in this instance, of 5 square feet), for supposing the common paddle-wheel can be beneficially immersed to the depth *a b* of the diagram, its efficiency would be greater, by the direct action of boards of the same depth at *a b*, than by the oblique action of those in the position *c c*. If I am correct, several of the calculations in the tables referred to, would require reconsideration.

I am, Sir, your obedient servant,

"B. B."

October 27, 1842.

MR. MARTYN ROBERTS'S IRON BATTERY FOR BLASTING ROCKS BY GALVANISM.

Sir,—It gives me great pleasure to find that my process of blasting by galvanism has been so successfully employed by your able correspondent "W. C.;" and, on reference to the account of the operations at Dunbar Harbour, quoted in your 1000th Number, he will see that the simultaneous explosions on my plan were there most effective.

The iron blasting battery "W. C." wishes me to describe, I contrived in order that the cost of the apparatus should be reduced as much as possible, that its arrangement should be of the most simple kind, and that but little trouble should be needed in setting it at work or keeping it in order. Iron, as a material for the negative plate, is not only much cheaper than copper, but is also more effective. It is true that, under certain circumstances, (such as when loaded with rust,) it is less efficient; but when moderately clean, and excited by dilute sulphuric acid, I have found it far more powerful than copper as a negative plate in the galvanic series, (*vide* my experiments on this subject, as published in the *Phil. Mag.* for January, 1840;) and the cause of this superiority in iron I have pointed out in a subsequent Number of the same periodical, for June, 1841.

Before the iron plates are used, they should be cleaned of the dark blue oxide which has adhered to, or indeed been rolled into their surfaces by the process of manufacture they have undergone: this is best done by keeping them for half an hour in dilute sulphuric acid, or in a solution of sal ammoniac, and then giving them a dip in dilute sulphuric acid. There are no cells or partitions between the plates in this battery, and one great inconvenience is thus obviated. It is true that this arrangement prevents our obtaining the full *intensity* of the instrument, *i. e.*, the power of carrying its electric force through a great length of wire; but, so arranged, we gain portability, simplicity of construction, and perfect security against derangement by any clumsiness of the workman using it. I could describe a battery of much greater power than this, but its complicated form would require an electrician to work it with constant success; and I think it better to sacrifice a little power, in order to obtain the advantages I have before mentioned.

On reference to my pamphlet on the subject of blasting, it will be seen in what manner the power to overcome obstacles, or convey the electricity to a distance, and that to act upon bodies, can severally be obtained, without increasing the complexity of the apparatus. (See pp. 25 and 26.) The batteries I recommend for the use of workmen consist of twenty plates of iron, (copper may be substituted if preferred,) and twenty plates of zink, each 7 inches square. The thickness of the plates is immaterial: the iron need not exceed 15 or 20 ounces to the square foot. A wooden frame is made to receive these plates; the sides of the frame are bars, and the ends solid; these ends rise about two or three inches above the square of the top of the plates, for the purpose of supporting the apparatus for making contact. The bottom of the frame consists of two bars each, placed about a third of the width of the frame from the sides. These bottom bars not only support the metal plates, but also the strips of wood that maintain the plates separate from each other.

Fig. 1.

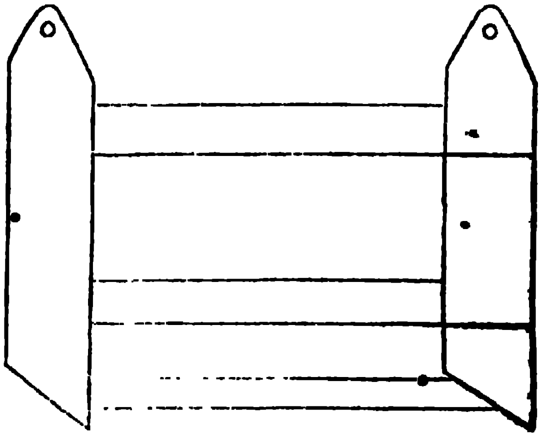
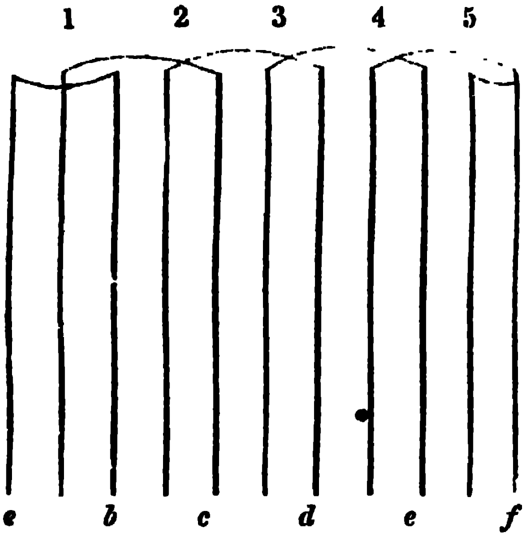


Fig. 1 shows the arrangement of the frame. The iron and zink plates are put into the frame alternately, that is, an iron plate is put close to one of the solid ends, then a zink plate next to the iron, then another iron plate, and so on, until the frame is filled, care being taken to finish the series by an iron plate. The plates are prevented from touching each other by strips of wood, $\frac{1}{16}$ths of an inch square, and as long as the plates are

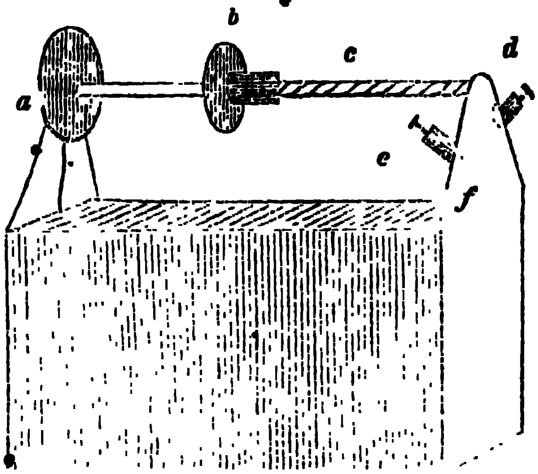
deep: two of these strips are placed between each plate, and their lower ends rest upon the bottom bars. The plates should be jammed sufficiently tight together to prevent any motion in the strips of wood. The mode of connecting one plate with the other requires some little attention, as a mistake in this will greatly diminish the power of the battery. I have endeavoured so to contrive the connexion as to obtain the action of both surfaces of every plate, and yet to avoid any cross and counteracting currents of electricity. Let fig. 2 represent a section of 5 pairs: let the letters indicate the iron plates, and the numbers the zink plates.

Fig. 2.



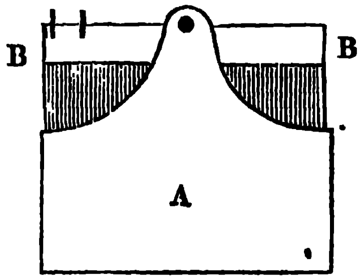

Let *a* and *b* be joined together and stand free as a double terminal plate, or pole, having of course a wire proceeding from it as a conductor; then join 1 to *c*, 2 to *d*, 3 to *e*, 4 to *f*, and 5 in this series of 5 pair will be a zink plate unconnected with any iron plate, but having a wire soldered to it going off as a conductor in the usual way from the other terminal pole of the galvanic series. In the same manner is a series of 20 pair put together, and connected in the frame as in fig. 2, by means of *thick* wires or strips of metal carefully soldered to them. The several plates are separated each from its nearest neighbour, by the strips of wood already described. The plates being thus arranged, the wire soldered to the double iron plate (see fig. 3) is fastened to the fixed disk of the apparatus for making contact, described in the pamphlet, and the wire joined to the zink plate terminating the series (as 5 in fig. 2) passes through the solid end of the frame, and terminates in a binding screw. The spring of the sliding disk is of brass wire, and the extremity not soldered to the disk passes through the same solid end of the frame and terminates on the outside in a binding screw; these two binding screws are to hold the ends of the conducting wire, (sec. 46.)

Fig. 3.




*a*, is the fixed disk; *b*, the sliding disk; *c*, the brass spring terminating in *d*, a binding screw; *e*, a binding screw soldered to *f*, the wire of the terminal zink plate. It is needless for me here to describe the apparatus for making contact, as an account of it has already appeared in your pages.

Fig. 4.




The box for containing the exciting solution (1 part sul. acid to 16 of water) is generally made of ¾th inch plank, the joints dovetailed, and set together with white lead; this will make it water-tight. The box should be about an inch longer and wider, and two inches deeper inside measure than the frame of plates; and I have found it convenient, that the box be fitted with two uprights, or standards, at the sides, with a sliding pin across from one to the other, for the purpose of supporting the frame of plates raised from the acid, and thus allowing the liquid adhering

to them to drip into the box; this cross pin is also useful in carrying the whole apparatus from place to place when the box is full of the exciting solution.

A, fig. 4, is the box for containing the acid.

B B, the frame plates supported by the cross pin going from standard to standard.

In the description I have heretofore given of the process of firing by galvanism, I have recommended that the fine steel wire of the cartridge *be soldered* to the horns of the cartridge communicating wires; but I now find it more convenient and equally efficient to bend the extreme points of the horns upon themselves as hooks; the fine steel wire is slipped across and under the two hooks, when a blow with a hammer on the hooks closes them, and fixes the fine wire securely, as thus. I need hardly mention the ne-

Fig. 5.

cessity of having all the metallic surfaces perfectly clean. The use of the kind of conducting wire explained in sec. 72, greatly facilitates the operations of blasting.

If these operations are on a large scale, it is better to cover the conducting wire with twine than with cotton, as it is more durable, and ensures a better insulation of the wires from each other.

If "W. C." intends fitting permanent batteries in his works, I may perhaps be able to point out to him some changes necessary for economy in such a mode of working the battery; and as it is possible I may shortly be in the neighbourhood of Liverpool, if "W. C." will send me his address within a few days, I will endeavour to call at his works, and be happy to give him all the information I can on this subject. I trust that all your readers that use my process will give a detailed account of their operations in your pages.

I am, Sir, yours, &c.

MARTYN J. ROBERTS.

October 17, 1842.

[Such of our readers as may be desirous of knowing more about the cause of the superiority of iron over copper as a negative plate, may refer with advantage to the notices of Mr. Roberts's discovery, which appeared in the Nos. quoted by him of the *Philosophical Magazine;* as also to the Memoir on this discovery read by Professor Poggendorff before the Berlin Academy, and Mr. Roberts's answer to the Professor's Memoir which will be found in the same journal. ED. M. M.]

## ON THE CONSTRUCTION AND USE OF COMMUTATION TABLES, FOR CALCULATING THE VALUES OF BENEFITS DEPENDING ON LIFE CONTINGENCIES.

### *Part* I.—*Introductory.*

It is to a Mr. George Barrett, of whom nothing besides is publicly known, that we are indebted for the principle of the Commutation Tables, and for the method of computing, by means of them, the values of benefits depending on the contingencies of human life. The method was first introduced to public notice, after it had been refused a place in the *Transactions of the Royal Society*, by Mr. Baily, in an Appendix to the second edition of his *Doctrine of Life Annuities*, published in 1813. Mr. Griffith Davies, in a work on life contingencies, published in 1825, by certain additions to the Tables, and alterations in their structure, according to Professor De Morgan, "increased the utility, and extended the power of the method to an extent of which the inventor had not the least idea." Mr. Barrett's method was also briefly noticed in the Appendix to Mr. Babbage's Treatise on Life Assurance. The method, as improved by Mr. Davies, has since been treated, and a very large collection of Tables adapted to it, for both one and two lives, has been given, by Mr. Jones, in his work on Annuities, in the *Library of Useful Knowledge*. But by far the most valuable papers on the subject are two in the *Companion to the Almanack*, for 1840 and 1842, by Professor De Morgan, which contain the materials of many thousand formulæ, applicable to almost every case that can occur. There is also some notice of the method in the article REVERSIONS, in the *Penny Cyclopædia*, which article is likewise the production, we believe, of Professor De Morgan.

The above-named are understood to be the only works in which the new method is, in any sort, treated. They certainly are not numerous; but they are sufficiently so, and well enough known, to have induced a general adoption of this method, to the exclusion of that previously in use, but for two reasons. The first is, the want of Tables adapted to this method; and the second, the want of an *elementary* and *systematic* treatise on the subject. The first of these wants is now amply supplied by the valuable collection of Tables published by Mr. Jones, above referred to; but the second still exists. It is no disparagement to the able authors of the works above named, to say that this is the case. Generally speaking, it has not been their object to furnish a treatise of this kind; and they have accordingly taken for granted, on the part of their readers, the possession of a degree of acquaintance with the subject, which very many, to whom the power of using the Commutation Tables would be of the greatest service, certainly do not possess. Professor De Morgan, indeed, expressly says, that all that will be found of demonstration in his articles "is intended for those who are familiar with the subject." Now, although the formulæ, according to this method, are extremely simple, and easily intelligible to any one who is acquainted with the merest rudiments of algebra, and who will take the small degree of trouble necessary to enable him to comprehend the notation employed; yet it is a result of our own experience, which we have no doubt can be amply confirmed by the observations of others, that most people view with mistrust, and will not willingly have recourse to formulæ, the *principles* of which they do not understand. And while Professor De Morgan's papers, in particular, have, doubtless, well served the end which, from the remark quoted above, the distinguished author appears to have had principally in view, we do not see that this forms any good reason why others, to whom a knowledge of this method of computation would be of service, should be prevented from availing themselves of the vast fund of information, regarding this method, which these papers contain.

It is, therefore, as an humble contribution towards the supplying of the deficiency, which has been shown to exist, that the present papers are intended; and if they shall serve to render more available than heretofore, to any of the numerous readers of the *Mech. Mag.*, the valuable papers to which reference has so often been made, the writer will consider himself amply rewarded for his labour. While he thinks that the task of rendering more generally intelligible the principles on which the new method is grounded will not be a difficult one, he trusts that, should his success not be commensurate with his wishes, he may at least be found to have aided in clearing the way for some one better qualified to do justice to a subject, which is daily growing in interest and importance.

The peculiarities of the old and the new methods may be here briefly stated. In the old method, we are presented with a table of the values of annuities at all ages, which of themselves are rarely wanted, but from which, by operations more or less complex, the values of benefits of all other kinds may be computed. In the new method, on the other hand, we are presented with a table which, by mere inspection, tells us nothing; but from which, while the values of the ordinary benefits can be found by a simple division, those of benefits of the most complex description are found by operations consisting usually of nothing more than one or two subtractions and one division. In point of simplicity, moreover, in the deduction of the various formulæ, the methods admit of no comparison. For the establishment of what, according to the old method, required chapters, a few pages will suffice according to the new.

The opinion we have expressed as to the superiority of the new method, however, will probably be regarded as of little value; and that of Professor De Morgan, which is most unequivocally given, may perhaps be objected to, as the testimony of an interested witness, seeing he has bestowed such pains on the elucidation of this method. But Mr. Milne's testimony will certainly not be objected to on any such ground. He is the author of the best treatise that has appeared, or is now likely to appear, on the old method; and therefore his prejudices, if he has any, must be supposed to be all on the side of that method which he has done so much to illustrate. Speaking of Mr. Baily's work, he says, (*En-*

*cyclop. Brit.*, seventh edition, article, ANNUITIES, Vol. 3, p. 200.) "In an Appendix to it * * * formulæ were given for calculating from tables of that kind [Commutation Tables] the values of temporary and deferred life-annuities and assurances, when the annuity, instead of remaining always the same, increases or decreases from year to year by equal differences, *with considerably greater facility and expedition than the same things could have been done with by the tables and methods of calculation in previous use.*" And his testimony, be it observed, refers to the tables as devised by Mr. Barrett, and gives but a faint idea of their capabilities in their improved form.

We might now proceed to describe the Commutation Tables, referring for illustration to one which the Editor has kindly agreed to insert. But as it will be more convenient that the table should accompany the next paper, we prefer here disposing of some preliminary matters.

The construction of the Commutation Tables is effected by combining in a particular manner (which will be explained in the next paper,) the rates of mortality and interest; and, as in the tables adapted to the old method, any rates that are most approved of, as regards these elements, may be employed. But whatever may be the rates of interest and mortality made use of, the demonstrations and formulæ which will be hereafter given, being generalized by the employment of symbols, will be equally applicable to all tables of the same form.

The rate of interest according to which our table, (which has not been heretofore published,) is constructed, is 4 per cent.; and the rate of mortality is that given by Mr. Finlaison in his Twentieth Observation on the Mortality of the Government Annuitants (Parliamentary Paper, No. 122, 1829, page 58.) Tables of mortality in their usual form exhibit the numbers who, out of a number supposed to be alive at birth, or some other early age, attain each successive year of age, and consequently also the numbers who die in each year; and this form is the most convenient for the construction of Commutation Tables. But this is not the form in which Mr. Finlaison's data are arranged. What he gives are the *probabilities*, or rather the *logarithms of the probabilities*, that a life at each age will survive a year. A preliminary step therefore was, by means of these probabilities, to construct a mortality table of the more usual form; and in doing so, as well as in the subsequent construction of our Commutation Table, Mr. Finlaison's data have been made use of to *their full extent*. It is thought proper to mention this, because there is an "*abridged*" mortality table of the usual form, deduced from Mr. Finlaison's data, published in the Report of the Select Committee on Friendly Societies, 1827, page 82; and some might be embarrassed by finding that the results of our Commutation Table do not exactly correspond with those which may be deduced from the abridged table referred to. This table states the survivors of 1,000 births to be, at the ages of 6 and 7, for instance, 919, and 912, respectively; while the use we have made of the data enables us to say, that the survivors at these ages, out of 100,000,000 of births will be 91,912,811, and 91,239,410. As regards the correctness of our Commutation Table, it has been subjected to the severest tests in the way of verification, and we are confident that no error of any consequence will be found in it. Mr. Finlaison, in his Report, gives the values of annuities at all ages, at 4 per cent., as deduced from his data by the ordinary method, and carried to 7 places, which are two more than are usually given. The values derived from our table will be found to correspond with those to the last place. It has been thought proper to make these remarks as to the degree of confidence that may be reposed in our table, in case any one should feel disposed to apply it to practical purposes.

We shall now explain the notation, as regards the rates of interest and mortality, which we shall employ in our demonstrations.

It is shown by writers on interest, and indeed in most elementary works on Algebra, that if $r$ represent the interest of £1 for a year, then will

$1+r$ be the *amount* of £1 in 1 year.
$(1+r)^2$ .............. £1 „ 2 years.
$(1+r)^3$ .............. £1 „ 3 „
$(1+r)^4$ .............. £1 „ 4 „

and generally $(1+r)^x$ will be the amount of £1 in $x$ years, where $x$ may represent any number whatever, all at compound interest. It is also shown, that unity divided by the amount of one pound in a

given time, is equal to the *present value* of one pound, to be received at the end of that time; that is, to the sum which would, in the given time, just amount, also at compound interest, to one pound. Hence—

$\frac{1}{1+r}$ is the present value of £1 due at the end of 1 year.

$\frac{1}{(1+r)^2}$ .................. £1 .............. 2 years.

$\frac{1}{(1+r)^3}$ .................. £1 .............. 3 „

and generally $\frac{1}{(1+r)^x}$ is the present value of £1 due at the end of $x$ years, $x$, as before, denoting any number whatever.

It is usual to denote $\frac{1}{1+r}$ by $v$.

Hence, the foregoing present values will be more conveniently represented by $v, v^2, v^3, \ldots v^x$, respectively. It is obvious that the present value of any other sum; will be found by multiplying the present value of £1, due at the end of the same number of years, by the number of pounds in that sum. Copious tables of the present values of 1*l.*, due at the end of any number of years, from one to one hundred, together with their logarithms, are given in Mr. Jones's work, Part I.

The indications of the mortality table are represented as follows. The number shown by the table to attain to any age is denoted by the letter $l$, with the age attached as a suffix. Thus, $l_0$, $l_1$, $l_2$, $l_3$, $l_x$, &c., denote the numbers who attain the successive ages, 0, 1, 2, 3, $x$, &c., respectively. These symbols will, of course, denote different numbers in the case of different tables. Thus $l_0$, representing the number alive at birth, which is called the *radix* of the table, will, in the case of the Carlisle Table, be equal to 10,000, and in that of the Northampton Table, to 11,650; and the values of the other symbols will in like manner vary. But the great advantage of the use of symbols is, that we have no need to distract ourselves with their particular values, until we reach the final solution of the problem with which we may be engaged. Also, since the number who die in any year of age, that is, who enter upon that year and do not live to complete it, is equal to the difference between the number who complete that year and the number who completed the previous year, these decrements, as they are called, will be represented as follows:—

$l_0 - l_1$ is the number who die in their 1st year.
$l_1 - l_2$ ...................... 2nd
$l_2 - l_3$ ...................... 3rd
$l_{x-1} - l_x$ ...................... $x$th
$l_x - l_{x+1}$ ...................... $(x+1)$th

and so on, $x$ representing any age whatever.

We are now in a condition to enter upon a description of the Commutation Tables, and their construction; but this we shall reserve for our next paper.

G.

Hermes-street, Pentonville.

## COMBUSTION—THE CRANK DISCUSSION.

Sir,—As I was shutting my windows a few days ago, to keep out the visible and tangible particles of a metropolitan fog, the blackening influence of which, even the town *sparrows* bear witness to, when compared with their congeners in the country, I could not help thinking what a benefactor indeed, (I do not mean to the *sparrows*), Mr. Williams would be, if he could improve the combustion in our common grates, in the same degree as he has improved furnaces on a large scale.

It must be evident to every one, *that has ever poked a fire*, that large quantities of unconsumed gas, as well as smoke, are constantly escaping, only to add to the murky atmosphere without, so common here in the cold seasons of the year; gas in fact constitutes the greater part of what we commonly call smoke: and I believe it is also incontrovertible, that none of the most improved stoves hitherto invented, have succeeded either in burning all this gas, or in preventing the generation of smoke, during the combustion of that part of the gas which they do burn: yet surely when this object

has been attained in a furnace, we might expect to find it also attainable in an open grate. Mr. Williams's exact principle could not perhaps be brought into action, but might not an equally efficient one? Even burning all the gas would be a great improvement.

The origin of the form of our present grates has been evidently more a desire to fit them for *throwing out heat*, than any consideration with regard to attaining a perfect combustion: till of late years, all that was thought to be necessary, was to "put your combustibles in a convenient place, set fire to them, and let them provide themselves with air." Now on looking at a common fire-place, (particularly when a fire has been lately replenished), we perceive at once that almost all the smoke comes from the back and sides of the grate, and that the gas will not burn well in either of those situations; burning, when it does ignite, generally with a lambent Jack o' lantern flame, ready to die away every instant, from want of air; whereas the gas evolved in the fore-part of the grate burns brilliantly and without intermission. This seems to suggest that the grate should be *all front*, (being an Irishman, Sir, you know I am privileged—so no criticizing, if you please), or at least that such a state of things is a desideratum to be approximated to, as nearly as may be, without disregarding other requisites. This perhaps is already the case in several newly invented grates, as far as the sides are concerned, but I do not think I have ever seen a grate in which the back admitted a good supply of air.

I have said nothing, Sir, as to any means of preventing *bona fide* smoke, and for a good reason, because I am not aware of any; experiments in these matters require such "appliances and means to boot," that it is not everybody that can try them; but it would be well worth the while of any of your readers who have it in their power to do so. Perhaps this may meet the eye of Mr. Williams, and induce him to turn his attention, if he has not done so already, to this branch of a subject upon which he has already thrown so much light; even if it were only in pity to us poor metropolitans, condemned for half the winter to have the sun no brighter than a new copper penny.

I am, Sir,

Your obedient servant,

R. W. T.

P.S. I may take this occasion, Sir, to remark that your note appended to your correspondent "M.'s" last letter on the crank, would have been quite sufficient to stop any reply on my part, had I intended making one; but I beg leave to assure you, that, even had you not come forward at all, I should have made no attempt to answer such "air-drawn daggers" as were there aimed at me, they being but

"a false creation
Proceeding from a *crank*-oppressed brain."

## THE TREASURE SHIP "LE TELEMAQUE."

We learn from the *Journal du Havre*, that the works for the salvage of *Le Télémaque* are steadily advancing. The little town of Quillebœuf is quite alive with shareholders and speculators, who daily arrive, to satisfy themselves as to the progress of the undertaking, and to watch the market for shares, which mount in price as the long-buried wreck gradually rises from the sand.

The works having sufficiently advanced, the process of weighing was commenced on the 14th of October; and after every thing was tightened up, a stress of above 600 tons was applied, by means of powerful screws acting between the bridge raised on the vessel and the large platform constructed on the rocky bed of the river. The experiment was anxiously watched by all present, and no small uneasiness was felt by some, who saw the enormous timbers bend and creak, while the wreck appeared still as firmly fixed in the sand as ever. After about twenty minutes' screwing, the operations were suspended, and the vessel left to the operation of the current under this great strain. In about six hours the timbers had straightened; and when the screws were then again applied, the wreck, with the vast superincumbent mass of iron and timber, yielded to the force, and, once free from the suction of the sand, the whole, though of very great weight, became perfectly manageable.

The current having thus done its work in loosening and clearing the wreck, it became necessary to protect the works from its force, and additional piles were accordingly driven, to form a small breakwater, in case of storms. The weighing has also proceeded as fast as due precaution would allow; and by the close of last week, a workman had walked along the wreck, having the water only to his waist.

It will still demand some days to raise the *Télémaque* entirely above low water mark, to support her from beneath, and then to cut through all the chains and timbers to open and discharge her. The interest felt in France, now that the engineering question has been solved, is unprecedented. The demand for the shares is very great; but though a few may be picked up at from 10*l.* to 20*l.* each, the majority of the holders refuse to sell under *one thousand* francs for the hundred franc share.

### RAILWAY REFORM.

Sir,—I noticed with some surprise, in the last Number of your Magazine, a communication signed "George Cumberland," under the head of "Railway Reform," detailing what he is pleased to term "*A New Plan*" of working "a single railroad with as much efficacy as a double one," viz., by "sidings" or "turn-outs," to which he has applied the term "sinuosity." The plan is by no means so new as your correspondent seems to fancy. It has been applied, for many years, to the colliery railroads in South Wales, and various parts of the kingdom; but I am not aware that it has ever been used on railways for passenger traffic. Indeed, it must be evident to all persons acquainted with the practical working of railways, that this "*new* plan" is quite inapplicable to passenger railways. Had it not been so, it is not probable that engineers would have overlooked one so advantageous.

I am, Sir, your obedient servant,

T. Dyne Steele.

October 31, 1842.

### FILTRATION OF WATER.

Sir,—In your correspondent "W. H.'s" letter of October 15, it is stated, respecting the purification of water, that a very efficient filter may be made for less than 1*s.* 6*d.* It would oblige me much, and, no doubt, many others of your readers, if he would state how it is constructed; and, at the same time, whether it will take away the lime with which water, more or less, is impregnated, and which must be more or less prejudicial.

I am, Sir, yours respectfully,

A Subscriber.

22, Young-street, Manchester.
October 28, 1842.

### NEW PLAN FOR THE SUPPLY OF LONDON WITH PURE SPRING WATER.

Sir,—I have seen in the Mechanics' Magazine a discussion, upon certain observations made by the Rev. James Clutterbuck, on the periodical drainage and replenishment of the subterraneous reservoir in the chalk basin of London. I have read also various opinions and counter opinions on the subject, by some ingenious and very clever men, the general scope of which was to show that the deep wells, in and round London, will and do admit, of being nearly exhausted of water by the end of each week, and that if a large quantity is taken from any one locality, the other wells distant from that locality, are drained by it. If so, then, not a much greater supply of water could be obtained by adding to the number of deep wells in and round London.

A great deal has been said likewise of late about the quality of the water supplied by different water companies, to the overgrown and still increasing metropolis, and about the necessity of purification by filtration or some other means.

Now, if there really be a necessity of a better supply of pure water to the metropolis, I beg leave to propose a plan, that will most certainly afford a plentiful supply, and which could be carried out to such an extent, that the supply would become immense.

I propose not to meddle with the lower springs that are below the London clay formation and the chalk, but to collect the water from the upper springs, that form themselves at a certain depth from the surface of the earth.

I would commence operations with the basin of the Thames, above London, in the most convenient place, to form a surface reservoir. From that reservoir, I would carry a subterraneous archway up the valley, and parallel with the river Thames, but not communicating with it, nor following its windings, though approximating closely to it in some places. The river Thames of course rises against the stream; therefore the archway, by driving it up the side of the stream, would, by and by, be as deep as the bed of the river Thames, which I consider would be deep enough for my purpose. I would continue this arch-way drift still onwards; *but not level* as before, allowing it to rise as the bed of the river rises, and taking care always to be as low with it, as the bed of the river. By that time a large stream of water would be going out through the arch-way into the reservoir, and the supply for London would in a measure be commenced.

Let the drift-way be then continued up the vale of the Thames, and let lateral drifts from it be also made wherever any strata is intersected, that is likely to afford a large supply of water. The system might be thus extended to such a magnitude, that a great part, if not all London might be supplied by it, and as more and more water was wanted, it would only be necessary to continue the arch-way drift up the basin of the Thames to any distance, until the supply was enough.

A drift-way of 4 feet in width and height, would discharge an immense volume of water into the reservoir, on account of the rise that would be in it, from that level part of it, where it had first become as low as the bed of the Thames. For from that place the drift would rise as the bed of the Thames rises; consequently, the arch-way at the reservoir would discharge itself full of water, with a pressure behind it, from the drift-way rising far up the valley of the Thames.

The expense of the drift-way, per mile, would not be great. The pits down to it would be shallow, by keeping the drift near the side of the Thames, viz., to the depth of the bed of the Thames. A few of the pits might be left but covered over; the greater part of them should be filled up. The little damage done to the land, during the operation, would be made good behind, as fast as the drift was carried forward.

I have read of many hundreds of thousands of pounds being expended by Water Companies; but the whole of them would not produce such a supply of pure spring water as would result from the above plan. Besides, very little land would be damaged, and a great deal of land would be benefited by the drainage. I do not know how the vale of the Thames is situated with regard to London, for I never was there; but I should think the reservoir should be placed so far up the vale of the Thames, that the water should flow from it into London, without having to be pumped up by engines.

I believe such a drift would not cost so much money per mile as would an open canal, taking in the expense of land, aqueducts, bridges, &c., and it would be much less objectionable, for many obvious reasons. It would not interfere with any existing establishment; it would not be liable to inundation by land floods, nor be dependent on the irregular supply of surface water; it would receive its supply from the pure springs in the bowels of the earth.

I am, Sir, your obedient servant,

THOMAS DEAKIN.

Blaenavon, October 17, 1842.

## GAS FROM SOAP-SUDS.

A few years ago the immense quantity of soap-suds employed in the city of Rheims in preparing woollen stuffs was entirely lost. M. Houzeau Muiron conceived the idea of extracting from them the fatty matter, and of making an important application thereof. In fact, by submitting them to a regular purification, he has obtained a limpid oil, with which he succeeds in preparing the soaps in demand in commerce, while the residue of this purification serves for the advantageous production of a gas for lighting a part of the city.

The soap-suds collected in the shops, where they have become saturated with grease and the impurities of the tissues, are poured together into a large basin, which is capable of containing about 3,000 gallons. To decompose them, there is poured upon them 308 pounds of muriatic acid, or 154 pounds of sulphuric acid, first diluted with its own weight of water, and the mass is rapidly agitated until the decomposition is complete.

Shortly afterwards a froth is seen to form, which at the end of twelve or eighteen hours is sufficiently well separated from the water upon which it floats. Four-fifths of this water is then run off, containing about one per cent. of sulphate of potassa, which is utilized either by evaporating it in drying-houses, or by running it off upon dry earth exposed to the air, which, when sufficiently charged with the salt, is washed. Directly after this operation, the basin is filled again with a fresh portion of soap-suds, which float the fatty matter and permit it to be run off into a side tub. The product obtained is a mixture of unaltered oil, the acids, animal matters, and a large quantity of water, which forms with them a species of hydrate. This water is disengaged by injecting several times into the mass a current of steam, which heats it and facilitates its evaporation. The fatty matter is then run off into a boiler, where it is submitted to a rapid ebullition, aided by continual agitation, which drives off the last portions of water. The product contains twenty or twenty-five per cent. of impure matters, which colour it and render it turbid. To purify it, it is poured into basins of copper and mixed with two per cent. of concentrated sulphuric acid. After two days the limpid oil comes to the surface, while the impurities are precipitated to the bottom.

The oil is carefully separated, and the deposit, when filtered through cloths in a press, gives still a large quantity of oily products, which are added to the preceding and made into soap by treating them with common soda.

The residuum is black and very thick; from it M. Muiron produces the gas for lighting; but before introducing it into the retort, he liquifies it by means of the empyreumatic oil obtained in the preceding operation.

The gas thus prepared is purified by lime, and the water from the washing contains sufficient cyanide of calcium for the preparation of Prussian blue from it, by treating it with sulphate of iron and washing the precipitate with muriatic acid.

This gas possesses a considerable lighting power, and in order to apply it to the lighting of the establishments scattered throughout the city of Rheims, M. Muiron has contrived a manner of transporting it, at the same time simple, economical, and free from danger.

F. BOUDET.

Jour. de Pharm. et de Chim., May, 1842.

ECONOMY OF FUEL IN RAILWAY ENGINES.

The Commissioners for the Management of the Public Railways in Belgium, have lately directed much of their attention to the practicability of lessening the consumption of fuel in steam-engines. It is calculated that the heating of the boilers alone constitutes nearly one-half of the whole expense of the trains on railways. The system partially introduced of late is based on the principle that every head engineer shall be liable for the quantity of coals which he consumes. An account has accordingly been opened with each of them, in which the number of miles he traverses, and the precise time during which the locomotive is detained at the stations, are entered. Every three months, a Board of Engineers investigates the account, and determines the maximum quantity of coal which ought to be allowed. The difference which is found, after deducting the actual consumption from the maximum fixed, shows the amount of saving effected; and upon this difference the engineer becomes entitled to a premium of twenty-five per cent. on each hectolitre. Orders, varying from one to five hundred hectolitres, are delivered to the engineer once a month; and these orders are his warrant for the receipt of coals at the several stations. There is another advantage, too, in this regulation; the detention at intermediate stations does not exceed the time allowed; for the whole cost of the fuel, which a prolonged detention occasions, becomes a charge upon the engineer, let the cause be what it may. The quantity of fuel requisite for getting up the steam forms the item of a separate account with the engineer; and the plan has this collateral recommendation, besides—that it is a test of the care and trustworthiness of the parties employed.

NOTES AND NOTICES.

*Pearls.*—Letters from Norway mention that there have been found in the bed of the great stream that runs through Jedderen, in the diocese of Christiansand, and which from the excessive heats became dry, a great number of bivalve shells containing pearls, some of which were so large and fine that they were valued at 60*l*. a piece. At the beginning of the 17th century, when Norway was annexed to Denmark, the government took the pearl fishery of this stream into its own hands, and the finest pearls were sent to Copenhagen to be deposited in the crown treasury. After this, the produce of the fishery became so low, that it did not pay the expenses, and it was abandoned. It will now probably be resumed.

*Average Altitudes.*—At a sitting of the Berlin Academy of Science, of the 11th July last, H. Von Humboldt read a long memoir, upon the methods by which the comparative and average heights of continents might be ascertained. From the calculations of the learned gentleman, it appeared that the average height of Europe was 615 feet, of North America 648 feet, South America 1,035 feet, and of Asia 1,053 feet. The whole of these calculations were grounded on the assumption that each chain of mountains was to be taken as a bilateral horizontal prism, and that each high level should be considered as a plain, and should be brought down to a comparison with the level of the surrounding country. A careful calculation proceeding on this footing, gave as a result that the mass of the Andes' chain in South America, including the whole of the flat portion of the eastern borders, and the beautiful wooded heights uniformly distributed on those plains, and of which the level portion is exactly one-third larger than the upper levels of Europe, is only 486 feet higher than the average height of the latter quarter of the globe.

*Steam Navigation said to be invented by the Spaniards.*—A letter from Madrid, published in the *Commerce* French paper, contains an account of the discovery in the Royal archives of Salamanca, of authentic documents, proving what has heretofore rested on vague tradition. The following extract is from a register kept by the Minister of the Marine:—"In 1542 Don Blasco de Garray, captain in the navy, (Capitaine de Vaisseau,) submitted to the examination of the Emperor Charles V. a machine moved by the steam of boiling water, by which ships, however large, could proceed on a calm sea without oars or sails. The Emperor ordered that a trial should be made, which took place in the Roads of Barcelona on the 17th of June, 1543, and succeeded perfectly. This experiment was tried with a vessel of 200 tons burden, named Santissima Trinidad, commanded by Captain Don Pedro de Learga, who had arrived at Barcelona with a cargo of wheat. The Emperor Charles V. and his son, afterwards Phillip II., Don Enrique de Toledo, the Governor Don Pedro de Cardona, the Grand Treasurer Ravago, the Vice Chancellor Don Francisco Gralla, a great number of other distinguished persons of Castile and Catalonia, and numbers of naval officers, some on shore and some on board the vessel, were present at the attempt. The Emperor, the Princes, and the other illustrious personages, were astonished at seeing the ease with which the machine moved the vessel; but the Grand Treasurer Ravago thought it right to advise that the invention should not be adopted in the vessels of the State, because, according to his opinion, the machine was too complicated, and would be too expensive, and there would be reason to fear an explosion of the boiler." "The special commission ordered to report on the experiment, confined themselves to stating, that a vessel moved by steam had first completed three leagues in two hours, and then a league in an hour, and that it could be made to move twice as swiftly as a common rowing galley. The Emperor did not pay any more attention to the invention of Don Blasco de Garray, but he presented him with 700,000 maravedis, and promised to raise him successively to the higest rank in the Spanish navy. The late M. Raynouard, of the Académie Française, has left among his papers a ballad in honour of Garray, which was sung in the streets of Barcelona in 1542."—*Times.* [All this we have seen before; it is of most plausible circumstantiality; but, nevertheless, until we have something better than the authority of an anonymous "letter from Madrid," for the existence of the "authentic document," said to exist in the Royal archives of Salamanca, and for the correctness of the version here given of them, we must take leave to consider the whole affair as but an ingenious fiction.—Ed. M. M.]



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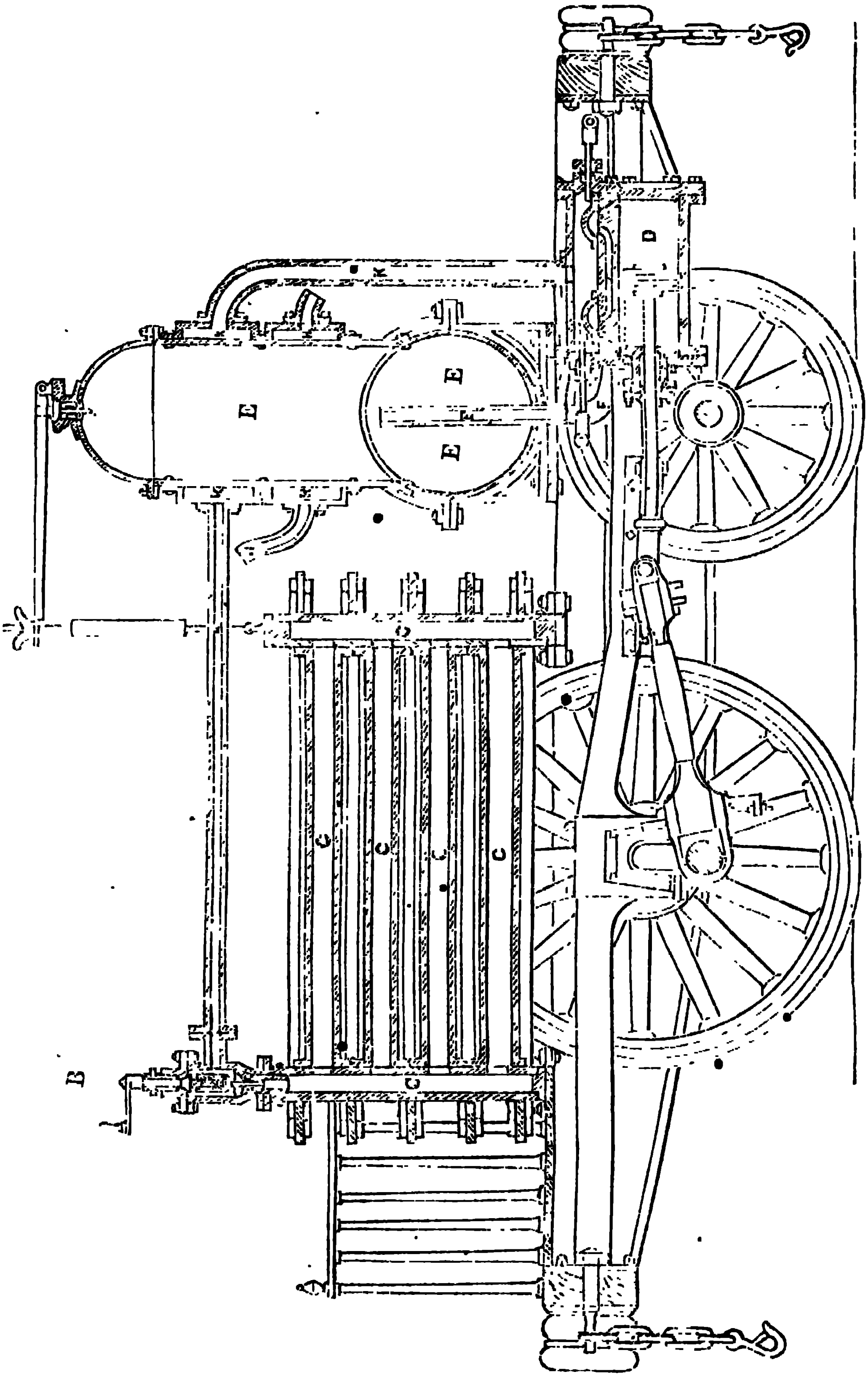


BAGGS'S CARBONIC-ACID-GAS LOCOMOTIVE.

## MR. BAGGS'S CARBONIC ACID-GAS ENGINE.

[Patent dated February 9, 1842. Specification enrolled August 9, 1842.]

The theory of the new power engine, which we have now to bring under the notice of our readers, is principally based on the discoveries of modern chemistry; and it may be as well, in a few words, to advert to these discoveries, before entering into the details of Mr. Baggs's application of them.

It is generally known, that many of those gases, which were formerly deemed permanently aëriform, are not so in fact, an alteration in their physical constitution being readily effected by specific variations of pressure and temperature. Carbonic acid gas assumes the liquid form under a pressure of 36 atmospheres, or 540 lbs. to the inch, at a temperature of 32°. Ammoniacal gas becomes liquid under a pressure of 6·5 atmospheres, at the temperature of 50°; and very slight increments of heat are sufficient to exalt the elasticity of these bodies to such an extent, as to render them competent agents for the movement of machinery.

Attempts have accordingly been made to substitute their powers for those of steam, but, as yet, with no successful result; the failure being mainly attributable to a want of economy in their production. Now, if we could manage, by any means, to *recover* these gases after they had done duty in the cylinder of an ordinary engine—if we could only save them from running to waste, cause them to perform their office over and over again, and effect all this at a small expense, it will be obvious that the great difficulty which has stood in the way of previous experimentalists would be avoided, and we should have at command an exceedingly cheap and portable power. This, then, is what Mr. Baggs has done; or, at least, shown the means of doing.

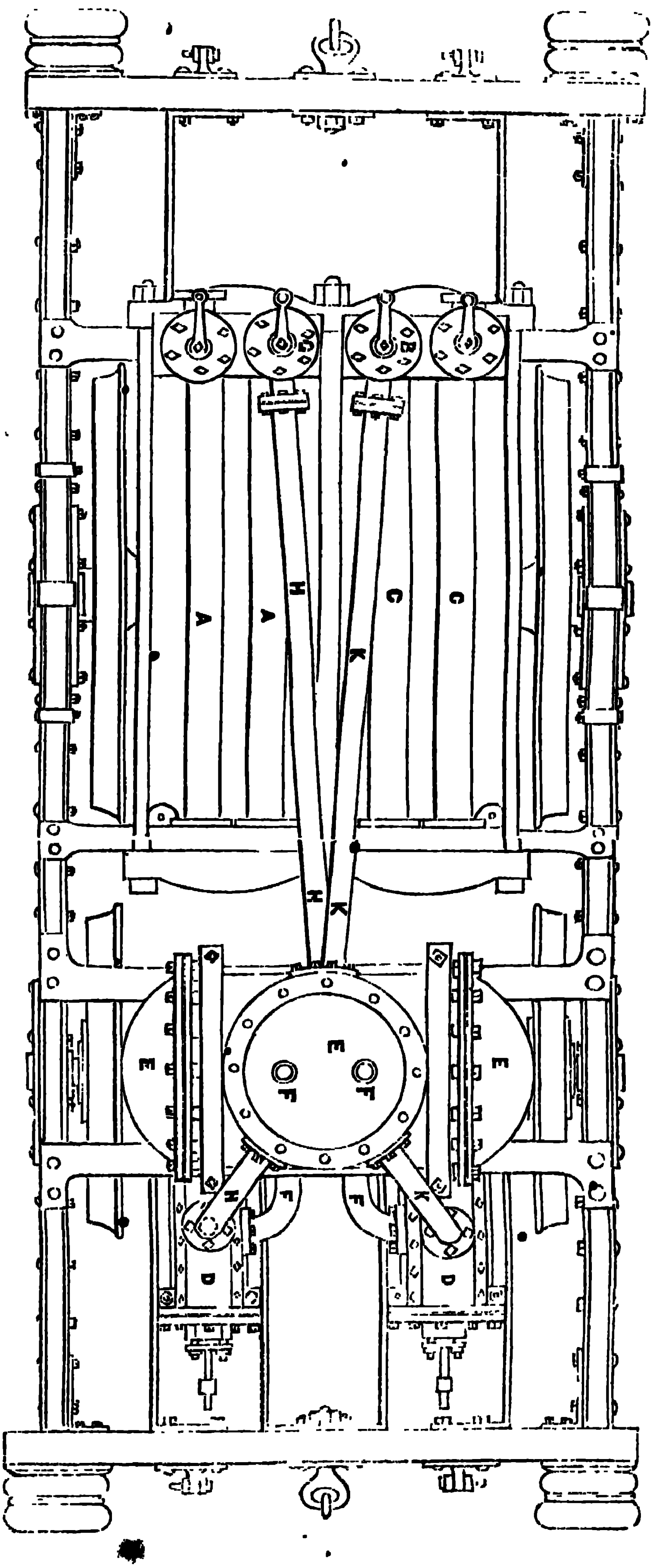
Mr. Baggs proposes to *generate the gas through the medium of a fixed acid and a carbonate of the volatile alkali.* For instance: by pouring *phosphoric acid* upon carbonate of ammonia, *phosphate of ammonia* is produced, and carbonic acid gas is driven off; and by subjecting this phosphate of ammonia to heat, it is decomposed, ammoniacal gas is liberated, and the phosphoric acid originally employed in the first part of the process remains behind. Here, then, is the regeneration of one of the materials by the aid only of a small quantity of fuel; and the recovery of the other is even more simple. The carbonic and ammoniacal gases, produced as above described, after performing the office of steam in an appropriate engine, are allowed, by virtue of their non-elasticity, to rush into an exhausted receiver, where they no sooner come in contact than immediate condensation ensues, with the reproduction of the exact quantity of carbonate of ammonia destroyed in the commencement of the process.

It will be observed that there are but *three* proximate elements concerned throughout—phosphoric acid, carbonic acid, and ammonia, which, by the consecutive influences of chemical affinity and caloric, are made to undergo a definite series of actions amongst themselves, with the resulting evolution of an enormous mechanical power.

With regard to the acid employed, Mr. Baggs does not consider it to be essential that the phosphoric should be used; any *fixed* acid will answer the purpose, and the boracic and sulphuric acids are offered as examples. The question of preference is one of economy alone. Phosphoric acid is one of the principal constituents of bones, and the process for its extraction is sufficiently simple. Boracic acid is found native, and may also be obtained in abundance from borax. Sulphuric acid, it is well known, is plentiful enough; and with reference to the other ingredient, carbonate of ammonia, the sources of its supply are perpetual, cheap, and abundant.

Supposing the invention to be applied to a locomotive, Mr. Baggs proposes to adopt the following routine. At any given station or line of stations, proper arrangements are to be made for carrying on the manufacture of the gases in the way we have described. As the latter are produced they are to be condensed into a liquid form, either by the chemical process of Dr. Faraday, or by the mechanical method of compression, which originated with Sir M. Isambard Brunel. The two liquids thus obtained would form the only load which the engine would be required to carry; and the carbonate of ammonia would be re-formed *on the road* as the liquids were expended. All the

Fig. 2.



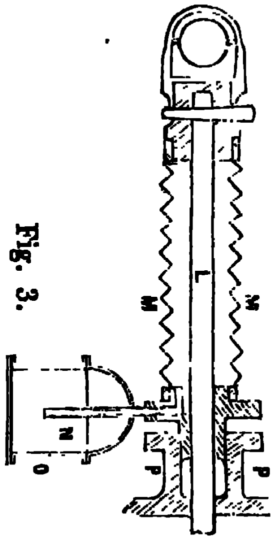




Fig. 3.

other parts of the process are to be conducted at the station. The engine itself is proposed to be constructed in the manner represented in the accompanying engravings.

Fig. 1 is a sectional elevation; C C C are a series of wrought iron tubes charged with *liquid carbonic acid.* The screws are very firmly connected together by screws and tie-bolts, and are subsequently rendered perfectly sound in all the joints by soft solder. B is a screw valve for permitting and regulating the escape of the carbonic acid. K is the induction pipe, which establishes a communication between the tubular reservoir C C C, and the cylinder D. Before the gas, however, is allowed to enter the cylinder, it is made to play round a limited portion of the circumference of the *condenser* E E E. F F are the eduction pipes leading from the cylinder D to the condenser. (The valve gearing is not shown in the engraving, as it is the same as that usually employed.)

Fig. 2 is a plan of the engine. A A is a tubular receptacle for liquid ammonia, similar in its general arrangement to that used for carbonic acid. G is the valve, and H the induction pipe for the ammonia. This latter is arranged in the same way as the induction pipe for carbonic acid, and the ammoniacal gas is made to circulate round another portion of the circumference of the condenser E E E.

To throw the engine into action, after it is charged with the two liquids, it will be only necessary to open the valves B and C; the carbonic acid and ammonia will immediately flash from the reservoirs in the form of gas through the induction pipes K and H; flowing into their respective cylinders, and thence escaping through the pipes F F into the condenser E, where they will enter into combination.

The condensation of the gases in E, will be attended by the evolution of a great quantity of caloric, and, in order to reduce the amount of this in the condenser, as well as to increase the elasticity of the gases before they enter the working cylinders, the induction pipes are made to embrace the condenser.

By the transfer of caloric (thus effected) from the interior to the exterior of the condenser, the pressure within will be lessened, and that without increased, the power being thereby nearly doubled. When the stock of liquid material is consumed, it is to be replenished at the station; and the carbonate of ammonia is to be withdrawn from the condenser, E E E, by the removal of one of the hemispherical ends which are shown in the drawing.

Another mode of employing the condenser, which Mr. Baggs points out, is by effecting a solution of the salt which it contains, and allowing the liquid to flow out.

In fig. 3, is shown a contrivance for preventing the escape of any ammoniacal gas into the atmosphere. L is the piston rod; P P the stuffing-box; M M is an air tight, flexible tube, capable of extension or contraction, and fixed at one end to the stuffing-box P, and at the other end to the head of the piston rod L. If any gas escape between the piston rod and the stuffing-box, it will immediately flow down the tube N into a quantity of muriatic acid contained in the vessel O, where it will be absorbed. A muriate of ammonia will be thus formed which may be removed at intervals from the vessel O.

A still better method of promoting the escape of both the gases would probably be, to form a similar elastic covering round both piston rods, and establish a free communication between them both to the condenser.

Some mechanical difficulties may very likely arise in the course of working out Mr. Baggs's ideas, but none which the perfect workmanship, for which our engine factories are so justly celebrated, does not justify us in expecting will be overcome. The invention we consider sound in principle, and hope soon to see it applied on such a scale of practical magnitude, as will effectually determine the question of its practical utility.

## DOCTOR PAYERNE'S METHOD OF PURIFYING THE ATMOSPHERE OF A DIVING BELL.

Sir,—Of all the wonders of the present age, there is, perhaps, not one that has attracted more universal attention than the fact, proved by Dr. Payerne, that a man may exist several hours below water without having any communication whatever with the external atmosphere, and it not being altogether known how the

doctor purifies the air, which, like other men, he must vitiate by respiration, I beg the favour of your giving publicity in your journal to the following remarks, lest, from the desire that now so universally exists of applying to practical purposes whatever discoveries are made in science, any one should think of repeating Dr. Payerne's experiments with such means only as he APPEARS to avail himself of.

It is well known that Dr. Payerne takes with him into the diving bell an air pump, and a vessel containing cream of lime and potash, and that he has therefore all the requisites for abstracting from the air the carbonic acid gas generated by respiration; but that body being formed by the combination of the oxygen of the air with the carbon of the blood, the question arises, how does he replace the oxygen consumed? It is evident, that if it be not restored to the air, the functions of the lungs cannot be properly performed, and death must soon ensue.

Chemical science does not show how the oxygen could be extracted from the carbonic acid gas generated and absorbed by the lime, nor does it appear how it could be obtained from the water in sufficient quantity for use, even supposing the apparatus used for decomposing water to be at hand, and that the hydrogen could be got rid of, and it therefore seems to me, that it must be taken into the bell in a compressed form in some part of the doctor's apparatus. Supposing this to be the case, the expense of the application of Dr. Payerne's discovery to the common diving bell, compared with that of the air pump, may readily be ascertained by those who are familiar with the use of that instrument.

An adult consumes about 125 cubic feet of air per day, equal to 25 or 26 cubic feet of oxygen, or rather more than 1 cubic foot per hour, and this quantity cannot be made and compressed into a vessel at a less expense than 1*s.* per cubic foot. To the expense of the gas is to be added that of the apparatus, such as the air pump, vessels to contain the gas, &c.; but it appears to me, that if, instead of the air pump that is used in the bell for forcing the air through the lime, a silk bag moving in a frame were adopted, a far more efficient machine would be obtained at a considerably less expense. To exhaust a vessel of its air, such as the receiver of an air pump, a machine capable of resisting great atmospheric pressure, and of great powers, is absolutely necessary; but where the pressure on the inside and the outside is the same, no such strength or power can be required—even a common pair of bellows would, I should think, answer every purpose required.

Dr. Payerne's method of purifying the atmosphere of a diving bell is a very ingenious and a highly philosophical application of chemical science, and one that will afford the means of definitely ascertaining the effect of respiration on the atmosphere; any attempt therefore, on his part, to throw the veil of mystery over that which he has done, can have no other effect than to detract from the praise he is so justly entitled to.*

F. C.

London Mechanics' Institution, November 8, 1842.

## HOW TO MAKE AN ALLOY OF LEAD AND IRON BY THE ELECTROTYPE PROCESS.

Sir,—You expressed an opinion, a short time back, that no perfect alloys of any of the metals have as yet been performed by the electrotype process. Now, I have deposited on copper an alloy of lead and iron, two of the most difficult metals to make an alloy of; and, as it may be interesting to some of your readers, I will describe the very simple process of doing so.

In a nitric solution of lead I put a solution of sulphate of iron (copperas;) the solution was cold, and not very strong;—when the solution was too strong, the sulphate of lead did not precipitate, but became a black liquid, which did not answer. The liquor remaining, after the sulphate of lead has been precipitated in white powder, is the solution containing sufficient iron and lead to electrotype with. The alloy was much harder than lead—would not melt at a strong heat, considerably above the temperature that lead melts at—and was magnetic, yet could be cut with a knife. The most singular part of the circumstance is, that

* Our correspondent is evidently not aware that Dr. Payerne has taken out a patent for his invention (in the name of Mr. Vigers,) the time for lodging the specification of which has not yet elapsed. Dr. Payerne, therefore, is doing no more than prudently availing himself of the time allowed by law for specifying his invention.—ED. M. M.

the two most unmanageable metals, to make alloys of, can by electricity become the most manageable.

I am, Sir, &c., M.

## MR. LUCY'S SUBSTITUTE FOR THE FLY-WHEEL.

Sir,—I am obliged to your correspondent "$\pi$." for referring me to the work where Mr. Lucy's improvements on the steam-engine is fully described. It has no fly-wheel whatever, it appears, but in place of it there is a cogged-wheel made fast on the crank shaft, the diameter about twice the length of the throw of the crank; and this wheel takes a smaller wheel, made fast to the axle of a second crank, which latter is one half the dimensions of the former, so that two revolutions of the large wheel will make the small wheel give four. Farther, there is a connecting rod and beam to the second crank, and a cylinder and piston rod at the other extremity of the same, which cylinder has a bottom but no top, and is the pneumatic apparatus for equalizing the motions, for which purpose the arrangement is admirably contrived. A little consideration will show, that the pressure of the atmosphere acting on the piston of the second cylinder, will make the main crank pass the centre by a simpler arrangement than would be required with a double engine; and I am surprised that your correspondent should have expressed himself in the manner he has done, relative to this improvement, which appears to me to be one of greater consequence than any which has been made in the crank engine for many years. Your correspondent admits that Mr. Parkes's authority, as far as the stating of facts is concerned, is unquestionable; the same also with respect to Mr. Scott Russell. Now the latter gentleman admits that the increased work of each pair of stones was in the proportion of 56 to 52, and Mr. Parkes states that an additional pair had been put up in the mill. And these, be it observed, are not inferences but naked facts; and your correspondent himself admits that the friction with the new contrivance must be, as no doubt it is, considerably greater than the friction with the fly-wheel. Why then, let me ask, can he doubt the inference drawn by Mr. Parkes from these data, that the power of the engine is considerably increased, and fully to the extent of 11 per cent? But your correspondent contends, that if such be a fact it is incumbent on Mr. Parkes to prove (as the increased power, he says, could come from no other quarter), that there must be less friction in the new apparatus than there was with the old fly-wheel. I do not consider this a very logical conclusion, for it amounts to this, that unless he proves an impossibility, his facts must go for nothing. Mr. Parkes, according to his notion, must connect his facts with your correspondent's conclusions, while at the same time he will not connect his mathematical conclusions with the facts which he admits are undeniable. He expresses himself also in a strange way, with respect to the statement made by Mr. Scott Russell; as for instance, that he is surprised he should have stated such and such facts, doubts whether he knew the bearings of them, that it is to be regretted that he did so, &c. Why, did your correspondent expect that Mr. Russell would have acted so disingenuously and improperly, as to be deterred from stating facts even had they gone counter, as they have, in this instance, to his own published opinions?

One example of the mode in which your correspondent draws erroneous conclusions from facts worth nothing is particularly deserving of notice. No doubt a hundred apples purchased at the market will not, with any newly discovered basket deliver 111 apples at home; but he concludes from this that another hundred apples sent home in another description of basket, could not deliver less than the hundred. With holes in the basket, for instance, there might be several lost, and but 80 delivered. The analogy is anything but complete; mathematicians are not bound to connect mathematical facts with practical ones; but practical facts, according to his views, must be proved not to vary from mathematical ones; while at the same time it is admitted, that all the elements connected with the practical fact are not embraced in the other case.

In conclusion, I should be glad to know your correspondent "M's." opinion on Mr. Lucy's improvements; I mean whether he would think there is any loss by such an arrangement of crank movements.

I am, Sir,

A Looker On.

## ON THE CONSTRUCTION AND USE OF COMMUTATION TABLES, FOR CALCULATING THE VALUES OF BENEFITS DEPENDING ON LIFE CONTINGENCIES.

[We find it will be more convenient, instead of the notation proposed in our first paper, (p. 428,) to represent the indications of the table of mortality, to make use of the following, which will therefore be adhered to in the remainder of these papers. We shall employ $l$, with the age attached, not as a suffix, but enclosed in parentheses, to denote the number who attain each age. Thus, the numbers represented by the table to attain the ages 0, 1, 2, 3,...... $x$ years, will be respectively denoted by $l(0)$, $l(1)$, $l(2)$, $l(3)$, ... $l(x)$. And hence, the number who die in their 1st year will be denoted by $l(0) - l(1)$
2nd ........................ $l(1) - l(2)$
3rd ........................ $l(2) - l(3)$
$x$th ........................ $l(x-1) - l(x)$
$(x+1)$th ................. $l(x) - l(x+1)$ and so on.]

### *Part II.—Description and Properties of the Tables.*

We propose in the present paper to describe the Commutation Tables, explain their construction, and show the algebraical properties that belong to them in virtue of that construction. We refer for illustration to the Table contained in the two following pages.

The Table consists, it will be seen, of two side columns containing the ages, and five inner columns, headed D, N, S, M, and R, respectively. There is another column headed C, which is essential to the theory of the tables, and the proper place for which, if inserted, would be between columns S and M. But as this column is not required in practice, it is never exhibited. The letters D, N, S, &c., are chosen quite arbitrarily, and have no reference to the signification of the columns at the head of which they are placed.

The number in any column, opposite to any age, is denoted by the letter at the head of the column, with the age attached, enclosed in parentheses. Thus, the number corresponding to age 20 in column D, for example, is denoted by D (20), in column N, by N (20), and so of the other columns. If the age be $x$, the corresponding numbers are denoted by D $(x)$, N $(x)$, &c.

The columns are constructed as follows: Take any age, 20, for example. The number in column D, opposite age 20, is equal to the product of the number represented by the mortality table to attain the age 20, into the present value of one pound due at the end of 20 years. So that the algebraical expression will be, $D(20) = l(20)\,v^{20}$.

And generally, the number corresponding to any age in column D, is equal to the number who complete that year of their age, multiplied by the present value of one pound due at the end of as many years as are equal to the age. Hence, the general expression for the value of the numbers in column D will be, $D(x) = l(x)\,v^x$,* $x$ denoting any age.

Hence also, if the age be 0, we have, $D(0) = l(0)\,v^0 = l(0)$, since $v^0 = 1$.

That is, the first number in column D is equal to the radix of the Mortality Table.

Column N is formed from column D, by inserting opposite each age in N the sum of the numbers opposite all the higher ages in D. For example,

$$N(20) = D(21) + D(22) + D(23) + \text{\&c. to the end.}$$
$$N(21) = D(22) + D(23) + D(24) + \text{\&c.}$$

So that the expression for the general term of this column is

$$N(x) = D(x+1) + D(x+2) + D(x+3) + \text{\&c.}$$

$x$, as before, denoting any age.

It follows from this that the last N in the Table is 0. For, since $N(x) = D(x+1) + \ldots$, if $x$ be the highest age, $D(x+1)$ and all the following terms vanish, since there are no survivors at the ages denoted by $x+1$, &c. Also, the first N in the Table is equal to the sum of all the D's except the first; or $N(0) = D(1) + D(2) + D(3) + \ldots$

Column S is formed by inserting in it, opposite each age, the sum of the numbers in N, opposite that age and all the higher ages. The expression for the general term is, therefore,

$$S(x) = N(x) + N(x+1) + N(x+2) + \text{\&c.}$$

* By an expression for the general term of a series, is meant, an expression in which a variable quantity is introduced, and which, by giving any particular value to the variable, gives the term of the series corresponding to that value. Thus, in the above general expression, $D(x) = l(x)\,v^x$, $x$, which denotes the age, is the variable; and if we give to it a particular value, we have immediately the term of the series corresponding to that value. For instance, if $x = 20$, the expression becomes,

$D(20) = l(20)\,v^{20}$;

and this is the value in column D corresponding to age 20.

## COMMUTATION TABLE.—SINGLE MALE LIFE.

GOVERNMENT RATE OF MORTALITY.—INTEREST 4 PER CENT.

| ge. | D. | N. | S. | M. | R. | Age. |
|---|---|---|---|---|---|---|
| 0 | 10000·0000 | 189251·4911 | 3483123·3173 | 2336·48113 | 57621·69308 | 0 |
| 1 | 9431·1674 | 179820·3237 | 3293871·8262 | 2152·26386 | 55285·21195 | 1 |
| 2 | 8905·8830 | 170911·4107 | 3114051·5025 | 1989·71684 | 53132·94809 | 2 |
| 3 | 8434·3219 | 162480·1188 | 2943137·0618 | 1860·68958 | 51143·23125 | 3 |
| 4 | 8008·6623 | 154171·4565 | 2780656·9130 | 1759·42701 | 49282·54167 | 4 |
| 5 | 7620·6994 | 146850·7571 | 2626185·4865 | 1679·48959 | 47523·11466 | 5 |
| 6 | 7264·0029 | 139586·7512 | 2479334·7294 | 1615·89696 | 45843·62507 | 6 |
| 7 | 6933·4451 | 132653·3091 | 2339747·9752 | 1564·72403 | 44227·72811 | 7 |
| 8 | 6623·2532 | 126030·0559 | 2207094·6661 | 1521·20284 | 42663·00408 | 8 |
| 9 | 6330·0454 | 119700·0105 | 2081064·6102 | 1482·73560 | 41111·80121 | 9 |
| 10 | 6051·0605 | 113648·9500 | 1961364·5997 | 1447·21386 | 39659·06564 | 10 |
| 11 | 5785·5704 | 107863·3796 | 1817715·6497 | 1414·45703 | 38211·85178 | 11 |
| 12 | 5532·5360 | 102330·8436 | 1739852·2701 | 1383·94450 | 36797·39475 | 12 |
| 13 | 5291·3215 | 97039·5191 | 1637521·4265 | 1355·52288 | 35413·45025 | 13 |
| 14 | 5061·0571 | 91978·1620 | 1540181·9074 | 1328·76796 | 34057·92737 | 14 |
| 15 | 4839·8510 | 87138·6080 | 1448503·4154 | 1302·22087 | 32729·15941 | 15 |
| 16 | 4626·0186 | 82512·5894 | 1361361·8374 | 1274·53377 | 31426·93854 | 16 |
| 17 | 4417·5780 | 78095·0111 | 1278852·2480 | 1244·01695 | 30152·40477 | 17 |
| 18 | 4213·8385 | 73881·1729 | 1200757·2366 | 1210·18431 | 28908·38782 | 18 |
| 19 | 4014·0326 | 69867·1403 | 1126876·0637 | 1172·41914 | 27698·20351 | 19 |
| 20 | 3818·9594 | 66048·1809 | 1057008·9234 | 1131·76185 | 26525·75437 | 20 |
| 21 | 3629·2895 | 62418·8914 | 990960·7425 | 1088·97492 | 25393·99252 | 21 |
| 22 | 3442·7376 | 58976·1538 | 928541·8511 | 1042·01100 | 24305·01760 | 22 |
| 23 | 3264·0617 | 55712·0921 | 869565·6973 | 995·74796 | 23263·00660 | 23 |
| 24 | 3094·1061 | 52617·9860 | 813853·6052 | 951·33340 | 22267·25864 | 24 |
| 25 | 2932·9909 | 49681·4951 | 761235·6192 | 909·22226 | 21315·92524 | 25 |
| 26 | 2780·7540 | 46901·2111 | 711550·6241 | 869·79274 | 20406·70298 | 26 |
| 27 | 2639·0772 | 44265·1639 | 661646·3830 | 835·06793 | 19536·91024 | 27 |
| 28 | 2505·0301 | 41760·1338 | 620381·2191 | 802·52378 | 18701·84231 | 28 |
| 29 | 2378·0529 | 39382·0809 | 578621·0853 | 771·89394 | 17899·31853 | 29 |
| 30 | 2257·6521 | 37124·4288 | 539239·0044 | 742·95673 | 17127·42459 | 30 |
| 31 | 2143·4127 | 34981·0161 | 502114·5756 | 715·55005 | 16384·46786 | 31 |
| 32 | 2034·9211 | 32946·0950 | 467133·5595 | 689·49752 | 15668·91781 | 32 |
| 33 | 1932·0753 | 31014·0197 | 434187·1615 | 664·91786 | 14979·42029 | 33 |
| 34 | 1834·6160 | 29179·1037 | 403173·4448 | 641·76920 | 14314·50243 | 34 |
| 35 | 1742·1788 | 27437·2249 | 373994·0411 | 619·89412 | 13672·73323 | 35 |
| 36 | 1654·3493 | 25782·8756 | 346556·8162 | 599·07143 | 13052·83911 | 36 |
| 37 | 1570·6596 | 24212·2160 | 320773·9466 | 579·01055 | 12453·76768 | 37 |
| 38 | 1490·8889 | 22721·3271 | 296561·7246 | 559·64988 | 11874·75713 | 38 |
| 39 | 1414·7080 | 21306·6191 | 273840·3975 | 540·81084 | 11315·10725 | 39 |
| 40 | 1342·1355 | 19964·4836 | 252533·7784 | 522·65027 | 10774·29641 | 40 |
| 41 | 1273·0650 | 18691·4186 | 232569·2918 | 505·20029 | 10251·64614 | 41 |
| 42 | 1207·7753 | 17483·6133 | 213877·8762 | 488·87461 | 9746·44585 | 42 |
| 43 | 1145·6257 | 16338·0176 | 196394·2329 | 473·17792 | 9257·57124 | 43 |
| 44 | 1086·6545 | 15251·3631 | 180056·2153 | 458·26918 | 8784·39332 | 44 |
| 45 | 1030·6715 | 14220·6916 | 164804·8522 | 444·08057 | 8326·12414 | 45 |
| 46 | 977·4798 | 13243·2118 | 150584·1606 | 430·53017 | 7882·04357 | 46 |
| 47 | 927·3068 | 12315·9050 | 137340·9488 | 417·95256 | 7451·51340 | 47 |
| 48 | 879·4023 | 11436·5027 | 125025·0438 | 405·71372 | 7033·56084 | 48 |
| 49 | 833·5711 | 10602·9316 | 113588·5411 | 393·70562 | 6627·81712 | 49 |

TABLE CONTINUED.

| Age. | D. | N. | S. | M. | R. | Age |
|---|---|---|---|---|---|---|
| 50 | 789·5001 | 9813·1312 | 102985·6095 | 381·69530 | 6234·14150 | 50 |
| 51 | 746·9195 | 9066·5117 | 93172·1783 | 369·17976 | 5852·41620 | 51 |
| 52 | 705·1776 | 8361·3341 | 84105·6666 | 356·16560 | 5482·96614 | 52 |
| 53 | 664·7128 | 7696·6213 | 75744·3325 | 343·12304 | 5126·50084 | 53 |
| 54 | 625·4090 | 7071·2123 | 68047·7112 | 329·38523 | 4783·37780 | 54 |
| 55 | 587·3511 | 6483·8609 | 60976·4989 | 315·38161 | 4453·99257 | 55 |
| 56 | 550·6411 | 5933·2198 | 54192·6380 | 301·26191 | 4138·61093 | 56 |
| 57 | 515·2537 | 5417·9661 | 48559·4182 | 287·05295 | 3837·34902 | 57 |
| 58 | 481·3810 | 4936·5851 | 43141·4521 | 272·99761 | 3550·29607 | 58 |
| 59 | 449·1615 | 4487·4236 | 38204·8670 | 259·29288 | 3277·29846 | 59 |
| 60 | 418·5753 | 4068·8483 | 33717·4434 | 245·98204 | 3018·00558 | 60 |
| 61 | 389·8164 | 3679·0319 | 29648·5951 | 233·32228 | 2772·02354 | 61 |
| 62 | 362·7862 | 3316·2457 | 25969·5632 | 221·28499 | 2538·70126 | 62 |
| 63 | 337·2557 | 2978·9900 | 22653·3175 | 209·70782 | 2317·41626 | 63 |
| 64 | 312·7669 | 2666·2231 | 19674·3275 | 198·19033 | 2107·70844 | 64 |
| 65 | 289·2939 | 2376·9292 | 17008·1044 | 186·74680 | 1909·51812 | 65 |
| 66 | 266·8385 | 2110·0907 | 14631·1752 | 175·11815 | 1722·77132 | 66 |
| 67 | 244·8012 | 1865·2895 | 12521·0845 | 163·61386 | 1547·35317 | 67 |
| 68 | 223.8080 | 1641·4815 | 10655·7950 | 152·06610 | 1383·70931 | 68 |
| 69 | 203·8598 | 1437·6217 | 9014·3135 | 140·72583 | 1231·64321 | 69 |
| 70 | 184·9140 | 1252·7077 | 7576·6918 | 129·62088 | 1090·91737 | 70 |
| 71 | 166·9336 | 1085·7741 | 6323·9841 | 118·75251 | 961·29649 | 71 |
| 72 | 149·9696 | 935·8045 | 5238·2100 | 108·20904 | 842·54398 | 72 |
| 73 | 134·1890 | 801·6155 | 4302·4055 | 98·19656 | 734·33495 | 73 |
| 74 | 119·7040 | 681·9115 | 3500·7900 | 88·87269 | 636·13839 | 74 |
| 75 | 106·3778 | 575·53365 | 2818·87847 | 80·15014 | 547·26570 | 75 |
| 76 | 94·11924 | 481·41441 | 2243·34482 | 71·98333 | 467·11526 | 76 |
| 77 | 83·30894 | 398·10547 | 1761·93041 | 64·79300 | 395·13193 | 77 |
| 78 | 73·11608 | 324·98939 | 1363·82494 | 57·80133 | 330·33893 | 78 |
| 79 | 63·41526 | 261·57413 | 1038·83555 | 50·91567 | 272·53460 | 79 |
| 80 | 54·36266 | 207·21147 | 777·26142 | 44·30211 | 221·61892 | 80 |
| 81 | 45·97142 | 161·24005 | 570·04995 | 38·00176 | 177·31681 | 81 |
| 82 | 38·23230 | 120·00775 | 408·80990 | 32·03076 | 139·31505 | 82 |
| 83 | 31·33915 | 91·66860. | 285·80215 | 26·60808 | 107·28429 | 83 |
| 84 | 25·24143 | 66·42417 | 194·13355 | 21·71872 | 80·67621 | 84 |
| 85 | 19·83120 | 46·59297 | 127·70938 | 17·27643 | 58·95749 | 85 |
| 86 | 15·13649 | 31·45648 | 81·11641 | 13·34145 | 41·68106 | 86 |
| 87 | 11·05347 | 20·403011 | 49·659931 | 9·843603 | 28·339614 | 87 |
| 88 | 7·702274 | 12·700737 | 29·256923 | 6·917542 | 18·496011 | 88 |
| 89 | 5·113615 | 7·587122 | 16·556186 | 4·625125 | 11·578469 | 89 |
| 90 | 3·249834 | 4·337288 | 8·969064 | 2·958021 | 6·953344 | 90 |
| 91 | 1·946549 | 2·390739 | 4·631776 | 1·779730 | 3·995323 | 91 |
| 92 | 1·152956 | 1·237783 | 2·241037 | 1·061004 | 2·215593 | 92 |
| 93 | ·6407773 | ·5970057 | 1·003254 | ·5931702 | 1·1545892 | 93 |
| 94 | ·3327112 | ·2642945 | ·4062485 | ·3097495 | ·5584190 | 94 |
| 95 | ·1605972 | ·1036973 | ·1419540 | ·1504320 | ·2486695 | 95 |
| 96 | ·0716510 | ·0320462 | ·0382567 | ·0676627 | ·0982375 | 96 |
| 97 | ·0258357 | ·0062105 | ·0062105 | ·0246032 | ·0305748 | 97 |
| 98 | ·0062105 | ·0000000 | ·0000000 | ·0059716 | ·0059716 | 98 |

And it differs from D in including, at each age, the number corresponding to that age in the preceding column. It follows from this, that the last S is 0, and that the first S is equal to the sum of all the numbers in column N.

The three columns just described are called the *annuity* columns.* The remaining three are called the *assurance* columns. The last named we now proceed to describe.

Column C is formed by inserting opposite each age, the product of the number who die in the following year of their age, by the present value of one pound to be received at the end of a number of years, which is equal to one more than the age in question. Thus,

$$C(0) = [l(0) - l(1)]\,v$$
$$C(1) = [l(1) - l(2)]\,v^2, \text{ and so on.}$$

And the expression for the general term will be $C(x) = [\,l(x) - l(x+1)\,]\,v^{x+1}$

Column C, as already remarked, is not shown in the table. It is used only for the construction of column M. And M is derived from it precisely as S was derived from N. So that the expression for the general term of this column is,

$$M(x) = C(x) + C(x+1) + C(x+2) + \&c.$$

Column R, also, is formed from M, in exactly the same manner as M was formed from C; and hence the expression for its general term is,

$$R(x) = M(x) + M(x+1) + M(x+2) + \&c.^*$$

We proceed now to demonstrate a few of the algebraical properties, and relations amongst each other, that belong to the numbers in the different columns. These will be useful for after reference, with a view to which we shall number them as we go along.

By algebraical properties and relations we mean those properties and relations that subsist in virtue of the mode in which the table has been constructed, without reference to what the numbers employed in that construction denote.

Among the algebraical relations must be classed those which we have just seen to subsist; which, therefore, we here repeat, for the convenience of reference.

$$\left.\begin{array}{l} D(x) = l(x)\,v^x \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \\ C(x) = [l(x) - l(x+1)]\,v^{x+1} \quad . \quad . \quad . \quad . \quad . \quad . \end{array}\right\} (1.)$$

$$\left.\begin{array}{l} N(x) = D(x+1) + D(x+2) + D(x+3) +, \&c. \\ S(x) = N(x) + N(x+1) + N(x+2) +, \&c. \\ M(x) = C(x) + C(x+1) + C(x+2) +, \&c. \quad . \\ R(x) = M(x) + M(x+1) + M(x+2) +, \&c. \end{array}\right\} (2.)$$

In what follows, we call $x$ the present age. And since, in the above expressions, $x$ denotes any age, we may substitute for it $x+n$, the only limitation† that we make with regard to $n$ being, that it shall not exceed the difference between $x$ and the oldest age in the Table, so that $x+n$ may not exceed that age. Making this substitution, then, the above equations will still hold, and we shall have

$$\left.\begin{array}{l} D(x+n) = l(x+n)\,v^{x+n} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \\ C(x+n) = [l(x+n) - l(x+n+1)]\,v^{x+n+1} \quad . \quad . \end{array}\right\} (3.)$$

$$\left.\begin{array}{l} N(x+n) = D(x+n+1) + D(x+n+2) +, \&c. \\ S(x+n) = N(x+n) + N(x+n+1) +, \&c. \quad . \quad . \\ M(x+n) = C(x+n) + C(x+n+1) +, \&c. \quad . \\ R(x+n) = M(x+n) + M(x+n+1) +, \&c. \quad . \end{array}\right\} (4.)$$

It thus appears, that the $n$th term from the present age, in columns S, M, and R, expresses *the sum of the* $n$th *and following terms* from the same age, in columns N, C, and M, respectively; and that the $n$th term from the present age, in column N, expresses *the sum of all the terms after the* $n$th, from that age in column D. If we wish *the sum of the* $n$th *and following terms* in D, we have only to write $x-1$ for $x$ in the first of the expressions (4), which then becomes,

$$N(x+n-1) = D(x+n) + D(x+n+1) +, \&c. \qquad (5.)$$

* It will be afterwards seen, that there is no necessity for employing those particular powers of $v$, which have been made use of in the construction of the table. The only condition as to these powers, which is indispensable to the possession by the table of the required properties, is, that their indices shall form an increasing arithmetical series, of which the common difference is unity. The powers that have been chosen possess the advantage of imparting to the expressions for the values of the numbers in columns D and C, a symmetry that would not otherwise have belonged to them.

† Algebraically considered, it is not necessary to make this limitation.

And, generally, it will be obvious, that to make our summation commence 1, 2, 3, &c., terms earlier or later, we have only to substitute in the expressions (4), in the former case $(x-1)$, $(x-2)$, $(x-3)$, &c., and in the latter $(x+1)$, $(x+2)$, $(x+3)$, &c., for $x$.

The expressions (2) and (4) enable us to find the sum of the first $n$ terms, either after or commencing with the present age, in the columns D, N, C, and M. For we have only to subtract from the sum of *all* the terms in these columns, after or commencing with the present age, the sum of those after or commencing with the $n$th from that age. Hence, the sum of the first $n$ terms, *after* the present age,

$$\left.\begin{array}{lll} \text{in D} & \text{is} & N(x) - N(x+n) \\ \text{N} & & S(x+1) - S(x+n+1) \\ \text{C} & & M(x+1) - M(x+n+1) \\ \text{M} & & S(x+1) - S(x+n+1) \end{array}\right\} \quad (6.)$$

And the sum of the first $n$ terms, *commencing with* the present age,

$$\left.\begin{array}{lll} \text{in D} & \text{is} & N(x-1) - N(x+n-1) \\ \text{N} & & S(x) - S(x+n) \\ \text{C} & & M(x) - M(x+n) \\ \text{M} & & R(x) - R(x+n) \end{array}\right\} \quad (7.)$$

Also, according to the principle laid down above, if in the expressions (6) and (7) we substitute $x+k$ for $x$, we are furnished with expressions for the sum of the first $n$ terms, either after or commencing with the $(x+k)$th.

Thus, the sum of the first $n$ terms, *after* the $(x+k)$th

$$\left.\begin{array}{lll} \text{in D} & \text{is} & N(x+k) - N(x+k+n) \\ \text{N} & & S(x+k+1) - S(x+k+n+1) \\ \text{C} & & M(x+k+1) - M(x+k+n+1) \\ \text{M} & & R(x+k+1) - R(x+k+n+1) \end{array}\right\} \quad (8.)$$

And the sum of the first $n$ terms, *commencing with* the $(x+k)$th

$$\left.\begin{array}{lll} \text{in D} & \text{is} & N(x+k-1) - N(x+k+n-1) \\ \text{N} & & S(x+k) - S(x+k+n) \\ \text{C} & & M(x+k) - M(x+k+n) \\ \text{M} & & R(x+k) - R(x+k+n) \end{array}\right\} \quad (9.)$$

If in the expressions (7) we suppose $n = 1$, they become, respectively,

$$\left.\begin{array}{l} D(x) = N(x-1) - N(x) \\ N(x) = S(x) - S(x+1) \\ C(x) = M(x) - M(x+1) \\ M(x) = R(x) - R(x+1) \end{array}\right\} \quad (10.)$$

If, in the expressions (10), we substitute $x+1$ for $x$, we obtain the same expressions as we should obtain by making $n$ in (6) $=1$. And in like manner, by substituting in (10) $x+k$, and $x+k+1$ for $x$, we obtain the same expressions as we should obtain from (9) and (8) respectively, by making $n=1$ in these expressions. The expressions just referred to, as well as others which may be derived by transposition from those we have given, we do not think it necessary to set down, since their mode of derivation is so extremely simple; and we shall accordingly refer, as we have occasion for them, to the expressions which we have shown to contain them.

Again, since

$$\begin{array}{rlllll} N(x) = & D(x+1) & + D(x+2) & + D(x+3) & + D(x+4) & + \&c. \\ N(x+1) = & & D(x+2) & + D(x+3) & + D(x+4) & + \&c. \\ N(x+2) = & & & D(x+3) & + D(x+4) & + \&c. \end{array}$$

and so on; if we add these equations together, observing that

$N(x) + N(x+1) + N(x+2) + \&c. = S(x)$, the resulting equation will be,

$$S(x) = D(x+1) + 2\,D(x+2) + 3\,D(x+3) + 4\,D(x+4) + \&c. \quad (11.)$$

And in the same way we should obtain

$$R(x) = C(x) + 2\,C(x+1) + 3\,C(x+2) + 4\,C(x+3) + \&c. \quad (11.)$$

Sometimes, in the Commutation Tables, the assurance columns are not exhibited. We therefore proceed to show how their place may be supplied by means of the annuity columns.

$$C(x) = [l(x) - l(x+1)]\,v^{x+1} = l(x)\,v^{x+1} - l(x+1)\,v^{x+1}$$

But $l(x)\,v^{x+1} = v\,D(x)$ and $l(x+1)\,v^{x+1} = D(x+1)$

Consequently $C(x) = v\,D(x) - D(x+1)$ . . . . . . . . (12.)

Again, since $C(x) = v\,D(x) - D(x+1)$

$$C(x+1) = v\,D(x+1) - D(x+2)$$
$$C(x+2) = v\,D(x+2) - D(x+3)$$
$$C(x+3) = v\,D(x+3) - D(x+4)$$

and so on, to the end of life; if we add these equations, observing that

$$C(x) + C(x+1) + C(x+2) + \&c. = M(x);$$
$$v\,D(x) + v\,D(x+1) + \&c. = v\,[D(x) + D(x+1) + \&c.] = v\,N(x-1);$$

and $D(x+1) + D(x+2) + \&c. = N(x)$; the resulting equation will be

$$M(x) = v\,N(x-1) - N(x) \quad . \ . \ . \ . \ . \ . \quad (13.)$$

The analogous expression for R, in terms of S, and which is obtained in precisely the same way, is

$$R(x) = v\,S(x-1) - S(x) \quad . \ . \ . \ . \ . \ . \quad (13.)$$

The expressions just deduced may be exhibited in a somewhat different form, which is, in certain circumstances, more convenient than the other.

Since by (10), $N(x) = N(x-1) - D(x)$ The first of the foregoing expressions, becomes by substitution,

$$\begin{aligned} M(x) &= v\,N(x-1) - N(x-1) + D(x) \\ &= D(x) - N(x-1) + v\,N(x-1) \\ &= D(x) - (1-v)\,N(x-1) \quad . \ . \ . \ . \ . \quad (14.) \end{aligned}$$

The corresponding expression for $R(x)$, obtained in the same way, is,

$$R(x) = N(x-1) - (1-v)\,S(x-1) \quad (14.)$$

Of the foregoing expressions, those numbered (1) to (11), are extensively useful, in deducing and simplifying the formulæ in the practical application of the tables; and the remaining expressions numbered (12) to (14), besides their use in supplying the place of the assurance columns when required, serve also to verify the tables. We have not space here to give examples illustrative of any of the foregoing formulæ. But these are so very simple, that this does not seem at all necessary.

For the convenience of those who may wish to test the table prefixed to the present paper, by means of the formulæ of verification given above, we subjoin the following elements.

When the rate of interest is 4 per cent, (as in our table.)

$$v = \frac{1}{1{\cdot}04} = {\cdot}96153846;$$

and its logarithm is ·98296666.
Also $1 - v =$ ·03846154;
and its logarithm is ·58502665.

We make a single remark before closing the present paper. The formulæ we have demonstrated may appear to some at first view, both complex and confused. They are nevertheless eminently remarkable for their simplicity and symmetry. This, a farther and practical acquaintance with them will make abundantly manifest.

In our next paper we propose to show how the present values of the simple benefits may be deduced from the Commutation Tables.

Hermes-street, Pentonville. G.

## MR. ZANDER'S TABLE OF THE PERFORMANCES OF VESSELS ABOVE BRIDGE—LAW OF THE VELOCITY OF STEAM-VESSELS.

Sir,—Since my letter to you of the 27th inst. I have been further studying the table given in your 1001st Number, page 359, of the comparative performances of seven steam-vessels; and combined therewith, that law in hydrostatics quoted in the excellent paper of "O. B. F." on Mr. Booth's system of propelling," (No. 992, Aug. 13, page 149.) "If any body move through a fluid at rest, the force or resistance of the fluid against the body will be as the square of the velocity, and density of the fluid."

Now, I have assumed that the square

feet of dynamical resisting surface assigned to each of the seven steamers mentioned in the above table is correct; and therefore that those numbers multiplied by the square of the velocity of the vessel is the amount of resistance which the paddle-wheels must necessarily overcome by acting against the water in the contrary direction; which (when reduced to the direct action of the paddles) will be equal to the number of square feet of acting surface, multiplied by the square of the velocity, at which the floats revolve. As there appears to be some doubt as to what is the area of resisting surface of the paddles, I have endeavoured to arrive at it, by dividing the resistance to the vessel (being the area of resisting surface, by the square of the velocity) by the square of the velocity of the paddles, and the result appears to confirm what I have asserted in my letter of the 27th, that the area of efficient paddle surface does not exceed the length of the paddle-board of both wheels, multipled by its greatest depth in the water. But more minute statistical tables are required of the correct dimensions of a great number of steam-vessels, their draught of water, loaded and unloaded, their exact speed per hour under similar circumstances,* and the correct number of revolutions of the paddles per *hour* instead of per minute before any very satisfactory conclusion can be pronounced.

The following will be the area of acting paddle-board surface, according to the foregoing calculation, if correct.

| | | | |
|---|---|---|---|
| Era . | $\dfrac{\text{resisting surface } 26{\cdot}485 \text{ sq. feet} \times \text{velocity } 9\frac{1}{8}^2}{\text{velocity of the paddles } = 12{\cdot}17^2}$ | | 14·99 |
| Thunder and Lightning . . | $\dfrac{19{\cdot}081 \times 10^2}{13{\cdot}275^2}$ | = | 10·877 |
| Minerva . . . . . . . | $\dfrac{22{\cdot}129 \times 9\frac{1}{8}\text{sq.}}{13{\cdot}96^2}$ | = | 9 5429 |
| Vivid . . . . . . . . | $\dfrac{24{\cdot}424 \times 9\frac{1}{2}^2}{14{\cdot}994^2}$ | – | 9 8046 |
| Eclipse . . . . . . . | $\dfrac{27{\cdot}246 \times 9^2}{12{,}566^2}$ | = | 14·041 |
| Thistle . . . . . . . | $\dfrac{25{\cdot}554 \times 9^2}{13{\cdot}7^2}$ | = | 11·028 |
| Dart . . . . . . . . . | $\dfrac{19{\cdot}516 \times 8\frac{7}{8}^2}{12{\cdot}17^2}$ | = | 10·37 |

These seven vessels, on account of their depth in the water, not much exceeding the depth of the paddles, give a nearer result than probably would be the case with vessels of greater draught of water, where some correction might be found necessary for unequal immersion.

I am quite convinced, with your correspondent "O B F," that "founded upon the law of quadruple resistance octupal power is the necessary consequence;" but the velocity and density being both doubled, appear to me to be the cause of the *quadruple* resistance only. The power of the steam engine, as applied in the vessel, is divided into two parts, one half acting directly against the water by the paddles, and the other half, or counter action, is that by which the vessel is propelled; and in order to double the velocity of the vessel, the force of the paddles against the water must be quadrupled, to counterbalance the quadruple resistance which the vessel will experience; thereby requiring an eightfold increase of the engine's power. If a stationary engine were fixed upon the shore, and a vessel attached thereto by a rope, in that case, quadruple the power in the engine would produce double the velocity in the vessel; but an engine upon the vessel, compared with this upon the shore, must have eightfold the power to overcome the same resistance in the vessel. Supposing the resistance of the vessel at one mile per hour to be repre-

* By the help of my wheel for measuring the velocity of fluids, (the correctness of which I have still further ascertained by measuring a distance of half a mile upon a canal bank, and leaving a mark at each furlong, when each wheel passed parallel thereto through the canal, recorded exactly the same distance,) a correct result might be obtained of the speed of any steamer upon the Thames, by noticing their velocity with and against the stream, and the velocity of the tide at the same time.

sented by 10, the following table will show the resistance to 10 miles per hour, and the power which an engine on board ought to have to overcome that resistance. But a vessel being provided with a sufficient power to propel her at the rate of 5 miles per hour, it would appear to require one of quadruple the power only to propel her at 10 miles per hour.

Is this view of the "octuple power" correct? Or are we to understand thereby, that *the power required increases as the cube of the velocity*, which was my first impression? The latter ought indeed to convince proprietors of steam-vessels, how extravagant would be the attempt greatly to exceed the velocity already acquired in steam navigation, when the difference of power at a speed of 8 or 10 miles per hour would be as 512 to 1000.

| Miles per hour | resistance of vessel | power required |
|---|---|---|
| 1 | 10 | 20 |
| 2 | 40 | 80 |
| 3 | 90 | 180 |
| 4 | 160 | 320 |
| 5 | 250 | 500 |
| 6 | 360 | 720 |
| 7 | 490 | 980 |
| 8 | 640 | 1280 |
| 9 | 810 | 1620 |
| 10 | 1000 | 2000 |

I am, Sir, your obedient servant,

Ben. Biram.

Walworth, Oct. 29, 1842.

ON LIGHTNING CONDUCTORS, ETC.—BY J. R. HILL, ESQ., C.E.

Sir,—In your 998th Number, Mr. J. Roberts claims the merit of having proposed wire rope conductors for shipping some years ago. If wire ropes were at that time known, Mr. R. was fairly entitled to credit for *suggesting the application;* but by far greater credit is due to any individual who will encounter all the difficulties, disappointments, expense, and the numerous discouraging circumstances attendant on introducing valuable improvements. Had Mr. Roberts done this, he would have deservedly obtained that consideration which he now claims for a written suggestion. I do not imagine that Mr. Smith claims the *invention* of wire conductors, though, having been the first maker, and perhaps I may be allowed to say, *inventor* of the wire rope and of its application for ships' conductors, it cannot be disputed that he deserves the credit of its useful application. Ships having wire standing rigging require no other provision as conductors than a perfect metallic communication from one set of shrouds to another, and from the lower ones to the water. This communication cannot be so easily effected by metallic substances in any other state as that of wire rope.

Mr. Roberts justly appreciates the value of conducting the electric fluid over the side, instead of through the hold of the ship. Mr. R. says, I am wrong in supposing that the electric fluid is conducted over the surface of metallic bodies, but that it is in the ratio of the *mass;* on this I shall feel most happy to be informed, for I can easily believe it is not a settled question. It is not enough for me to be corrected by saying "you are wrong"—I wish to know what is right.

In my juvenile days I was fond of electric experiments, and on using a prime conductor, made of tin plates, which was covered with a coat of black varnish, I invariably found that every discharge from the conductor brought off a speck of the varnish, laying bare the surface of the tin. I have frequently conducted powerful discharges over clean paper, with nothing more than a line made by a black lead pencil, in which case there was a measurable metallic surface, though but a mass too insignificant to support the solid theory. Dr. Priestley, wishing to satisfy his mind on the question, dipped a perfectly clean chain into melted resin, till it had a coating of a considerable thickness, and on sending a discharge through it, found that all the resin had been dispersed, leaving the chain perfectly bare. Other experiments in favour of the surface theory might be adduced, but I do not know of one supposing the contrary; though, no doubt, much may be said on both sides. The fusion of metallic leaves, wires, &c., only appears to prove that the quantity of surface is inadequate to the quantity of electricity, passing over, and therefore does not affect the question. Dr. Franklin supports the theory of the *mass*, but without any further authority than hypothetical reasoning. In the excellent philosophical work of Mrs. Somerville, it is asserted that electricity is conducted over, and in proportion to the surface. If Mr. Roberts, who appears an able writer, and is, I doubt not, equally able as

an experimenter, will be kind enough to give the form of an experiment, which shall satisfactorily prove the matter, I, for one, shall feel exceedingly obliged.

The experiments described in your No. 1002, which took place at Portsmouth, in presence of Sir Edward Codrington, appeared to have been a brilliant display of electricity, rather than leading to any useful result; as they proved nothing that was not before known. They failed to prove that conducting lightning into the hold of a ship, where by carelessness and inattention the conductors may be broken, lateral discharges take place, and serious consequences ensue by combustible substances taking fire, is safer than conducting it over the side, and from thence to the water.

I am, Sir,
Your obedient servant,
J. R. HILL.

98, Chancery-lane, November 3, 1842.

### BLASTING ROCK—SECURITY FROM ACCIDENTS—SAND TAMPING.

Sir,—I would not have troubled you with any remarks on the letter addressed to you by "W. C." (No. 1001), who seems to entertain different opinions from myself on some practical operations in rock blasting, but for the sake of humanity.

"W. C." states that the workmen unanimously prefer the old plan of firing the holes with straw, to the employment of Bickford's fuse; by which he manifestly implies that its use is attended with inconvenience.

Now I can state on the contrary, that having watched the introduction of this fuse to blasting-works, in very many places and during several years, I have never in a single instance met with master, overseer, or workman, who did not express the highest approbation of it; so much so, that I have known great impatience manifested for a renewed supply, when it had run short.

I am indeed inclined to believe that "W. C." speaks from report, and that he has not himself any actual knowledge of the application of the fuse, otherwise he would not have overlooked the very striking security it affords against the distressing accidents that frequently occur to workmen in the act of ramming down tamping, and sometimes in the act of firing.

If a comparison be made between the number of accidents that occur to men who use the fuse, and those who employ straws on the old plan, during the execution of the same amount of work, where tamping is rammed down in the usual manner, the difference will be found to be *very great.*

As regards the question of tamping with loose sand, there is no doubt but that its application is so easy, and free from almost a possibility of accident, that if it can be made to afford sufficient resistance, its use would be most advantageous.

"W. C." states that by leaving a space between the powder and the sand, the desired resistance will be obtained, and that he has never placed more than 18 or 22 inches of sand over any charge of powder.

I should be glad to know by what easy and cheap contrivance he preserves the vacant space between the powder and the sand; and I am strongly inclined to doubt the effect being so great as he thinks. The following experiment would, however, make this more clear.

In a hole in solid rock of 1 or 2 inches diameter and from 2 to 3 feet deep, insert from 18 to 22 inches of sand over a *small* charge of powder, say 1, 2, or 3 oz., with any space you please between the two, and my opinion is that even the smallest charge would blow out the sand, provided there were no peculiar resistance obtained from the contrivance used for preserving the space between the powder and the sand.

If such small charges on trial should have the effect I anticipate, it would prove that no essential advantage is gained by the space left as described.

Your obedient servant,
J. T. B.

### THE ECONOMY OF THE ATMOSPHERIC RAILWAY SYSTEM.

[From a Lecture delivered by Professor Vignoles, before the Royal Cornwall Polytechnic Society, October 6, 1842.]

It was well known to have been a matter of great discussion whether, on the Liverpool and Manchester line, stationary power should not be used instead of locomotive—and it was not without great hesitation that the latter was adopted. The objection to the stationary power was, the vast amount of force requisite to overcome the friction of the ropes, sheaves, &c., by which much power

was wasted; but with the atmospheric system what was there? A rope of air, without weight or friction—positively nothing but the carriages to carry—so that very nearly the full dynamic effect of the power generated was obtained; they had no additional resistance but what the friction of the piston in the tube and the opening of the valve might create; this, added to the friction of the carriages, was all that there was to overcome. On the locomotive lines, fully half of a train, on the average, consisted of the engine and tender; besides which, there was to be considered the expense of locomotive power, compared with stationary. It would be ridiculous in him, in Cornwall, to attempt to enlarge on the benefits of stationary over locomotive power. On the Blackwall Railway, the rope and pulley system was carried to the utmost possible perfection; but what was the peculiar result? It was admitted that this line was working at double the expense of many of the ordinary railways. The expense of carrying a train there was 7*s.* per train per mile, which was double of what it was on the North Union and Dublin and Kingstown Railways. The expense on the Belgian railways was about 4*s.*; the average of the American lines, only 3*s.*; the average in England was about 4*s.* to 4*s.* 6*d.* But here, what was the moving power?—it was a column of air. And what was the retarding power?—A column of air, also. The moving and retarding powers were alternately columns of air; and every engineer knew, that, if it were possible to apply an atmospheric buffer, it would be the most efficacious of all buffers. In the atmospheric system, a rope of air was substituted for one of hemp or iron, so that the *minimum* of friction, with the *maximum* of useful effect, was obtained. * * * Now for the price to be paid for this. He ventured to state, on his professional reputation and experience as an engineer, that the sum of from 10,000*l.* to 12,000*l.* a mile would make a most excellent railway, in any part of the country between Falmouth and Exeter. * * * * *

Then came the advantage of getting rid of the heavy rail and expensive apparatus required for the locomotive engines. The rail about to be placed on the extension of the Dublin and Kingstown line would probably weigh only about 18 lbs. per yard; and such a rail, for an atmospheric engine, was greatly stronger, in proportion, than the ordinary rail now used for a locomotive. He must be understood to speak always of a single line for the atmospheric railway; on that system it was impossible that two trains could travel together in the same direction, except they were at least one station, or three miles, apart—neither could trains travel in opposite directions, so as to approach each other within that distance—therefore, collision, and overtaking, and such causes of accident, were perfectly impossible. It was also clear that, from the construction of the apparatus, carriages could not get off the line of railway. Single lines would, therefore, be perfectly sufficient.

## NOTES AND NOTICES.

*The Smoke Nuisance.—Williams' Argand Furnace.*—The impulse given to the consideration of means for the removal of the smoke nuisance, by the late meeting to consider the subject, in this town, (Leeds,) and particularly by the provisions of our Improvement Act, which comes into operation next January, is as important as to many it may appear surprising. The other day we visted, in company with the Town Clerk, the Patent Argand Furnaces of C. W. Williams, Esq., erected at the works of Mr. William Hill, flax spinner, Mabgate. We saw the plan in operation applied to a wagon boiler, only completed last week; but beside it there is a Cornish boiler, to which the same principle has been applied for above nine months, with the disadvantage, however, of previously working to the chimney common to both boilers, so that the prevention of smoke from the fire attached to the Cornish boiler has hitherto been very imperfectly distinguishable by the chimney. On Tuesday, however, when the wagon boiler only was in use, the smoke was very dense when the operation of the patent air distributor was cut off, and entirely removed on its again being put in action. The coal was small, a common kind of slack; the method of firing was very simple, no precaution being used more than in ordinary firing. The issuing or non-issuing of smoke from the chimney depended on the action of the apparatus, as was repeatedly tested, and always with the same effect. The whole plan seems to consist in admitting the air to the boiler fire by a peculiar method of dividing it into small streams or jets, thereby mixing it immediately with the crude coal gas as it escapes from the fire-grate over the bridge. This mixture being highly inflammable, the flues (as we observed by the sight-holes provided at the exterior of the side-flues,) became filled with smokeless flame. The extensive adoption of Mr. C. W. William's method speaks much in its favour; we learn that it has been put on board nine steam-boats, and has been adopted for 140 furnaces in different parts of the kingdom during the last eighteen months.—*Leeds Mercury.*

*The Great Western.*—It has been announced "by authority," that at the late *quasi* sale of this vessel, she was bought in for the original proprietors. There were some *bona fide* offers, but none which came up to the minimum price which the Directors of the Great Western Company had made up their minds to accept.



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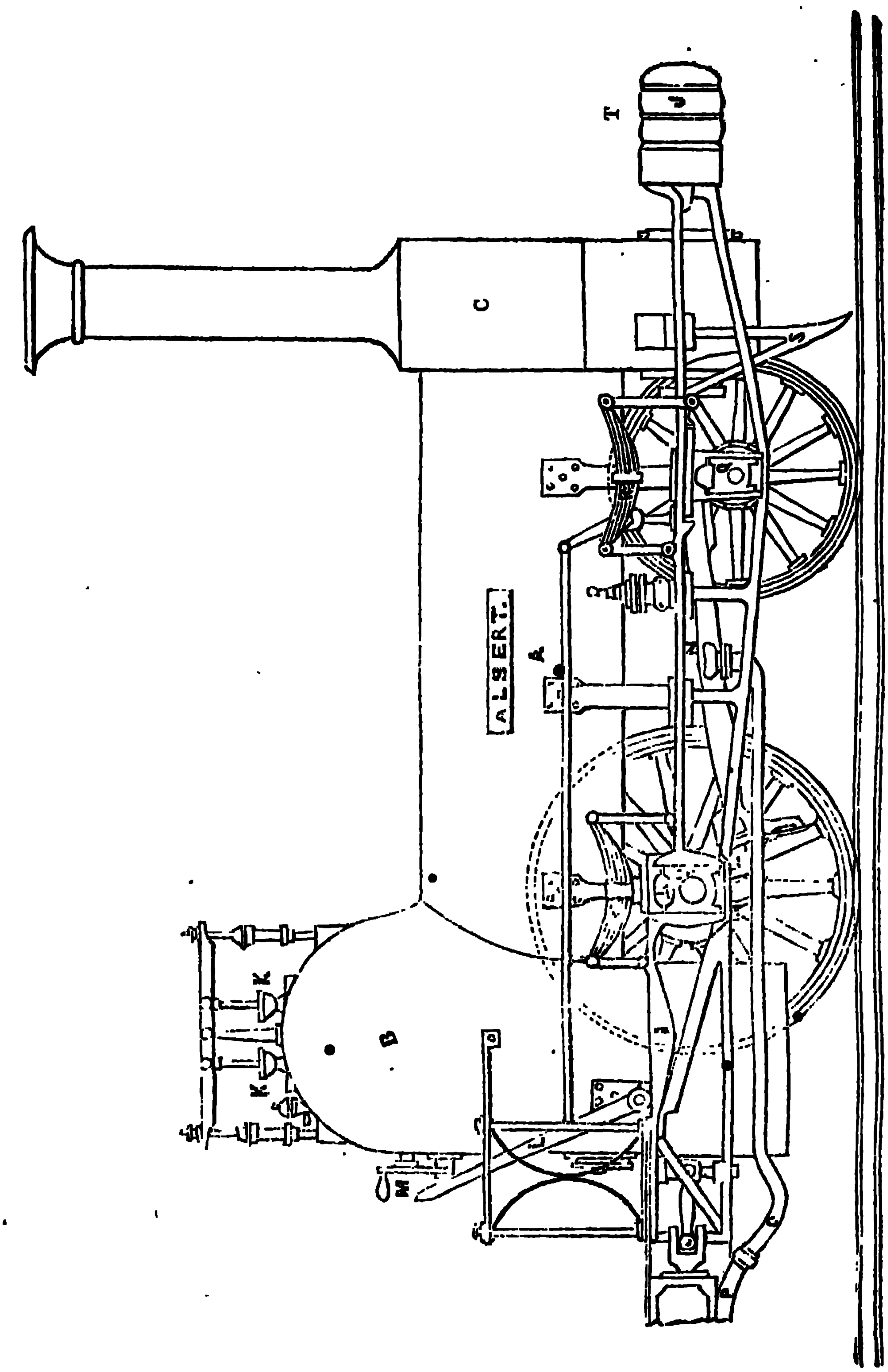
THE "ALBERT," OR MODEL FOUR-WHEELED LOCOMOTIVE ENGINE OF MESSRS. BURY, CURTIS AND KENNEDY.

Fig. 1.



## THE "ALBERT," OR MODEL FOUR-WHEELED LOCOMOTIVE ENGINE, OF MESSRS. BURY, CURTIS AND KENNEDY.

[The chief manufacturers as well as champions of the four-wheeled locomotive engine, as most of our readers are, no doubt, aware, are Messrs. Bury, Curtis, and Kennedy, of the Clarence Foundry, Liverpool, who make for the London and Birmingham Railway. "To show the process of reasoning, by which, aided by experience and the closest observation, they have arrived at the conclusion of preferring the four-wheeled to the six-wheeled engines," they have recently sent forth a Circular vindicatory on the subject, accompanied with engravings of the "Albert," one of their latest and best specimens of a first-rate four-wheeler. They were the more induced to do this, they say, because "there have not been wanting those whose anxiety to feed the public prejudice, and to profit by the effect of it, has led them to allege many things against four-wheeled engines, which are both untenable in principle and untrue in fact:" and because, also, "in all the discussions which have taken place on the subject, none, or scarcely any stress has been laid on that which is substantially the main feature of the whole case," namely, "the different effects of inside and outside bearings." Having ourselves taken a somewhat decided part in favour of the six-wheeled engine—though assuredly from no such motives as those glanced at above—we deem it only fair to make our readers acquainted with all that Messrs. B. C. and K. have to say on the opposite side. Our own opinions, certainly are not in the least shaken by this Circular; but we desire that our readers should judge for themselves. We would merely remind them, that the point in dispute (so far as the public are concerned) is, not which sort of engine is the cheapest, but which the safest; and beg also their attention to this remarkable fact, that Messrs. B. C. and K. do not touch once, throughout their Circular, upon what has been always considered the most serious objection to the four-wheeled engines —their tendency to jump off the rails. We published two or three weeks ago (*Mech. Mag.*, Oct. 8,) a communication from a "Practical Engineer," (a gentleman of as high authority on railway matters as Messrs. B. C. and K. themselves,) in which there are some facts stated about the jumping tendency of the four-wheelers, which may perhaps serve to show, why it is deemed prudent by the apologists of this class of engines to say nothing about it.—ED. M. M.]

### *Messrs. Bury, Curtis and Kennedy's Circular.*

* * * * * * *

The Manchester and Liverpool Railway was the first that ventured upon the use of steam locomotive power, for the conveyance of passengers at a rapid rate, and the first engine made for that great and spirited undertaking, in 1828, had six wheels. This engine, however, failed to give satisfaction, and a premium of 500*l.* was, in the same year, offered by the directors for the best engine. After many trials the premium was awarded to a four-wheeled engine.

The four-wheeled engines of that day had all of them outside frames, and were used on the Liverpool and Manchester Railroad for four or five years, without other objections than the loss from the breakage of axles, arising from the defective plan of the frame, viz., in its being placed outside the wheels.

Experiments were subsequently made, intended to show that economy of fuel resulted from the use of a large fire-box; but the consequence was, that this part of the engine became so heavy as to require support behind it, and hence arose the re-introduction of a third pair of wheels, which had been previously abandoned as highly objectionable.

The engine-makers generally of the country had no choice of the form of engine, but had to conform to the plans of the directors or engineer of the company, and did not examine minutely the merits of the new plan of construction, and engines continued, for some years, to be made ordinarily with outside frame, large fire-box, and six wheels.

It was the good fortune of the conductors of this foundry to originate the construction of four-wheeled engines, with inside framing, crank axles, and cylinders, placed in the smoke-box—all the practical and mechanical objections to the six-wheeled engines, and particularly with outside framing, having been foreseen at the earliest period. The first engine made upon this principle was manufactured in this foundry, in 1829, prior to the opening of the Liverpool and Man-

chester Railway. As the principle of the four-wheeled engine thus made gained publicity, great alterations have been introduced, from time to time, in ordinary six-wheeled engines, and at last we find, which we may be pardoned for adverting to with some satisfaction, that in the latest invention of an eminent engineer the outside framing is now being abandoned, or at least that the inside framing has been adopted in that instance, and the large fire-box dispensed with.

The frequent variations in the construction of locomotives serve to prove that the designers of the six-wheeled engines, with outside framing, are convinced that their plan was not a perfect one: whilst, in this foundry, the same plan has been continued with which we began, and to which others are now coming round.

This being, in brief, the history of passenger locomotives up to the present time, we think it due to ourselves to give the reasons why we have so perseveringly adhered to our plan of engine with four wheels only, and inside frames, and we cannot do better than give the following compiled extract from a paper published in the Transactions of the Society of Civil Engineers, and read before the society 17th March, 1840. It contains the statement of our opinions, of the soundness of which we had then had ample experience, and which still remain not only unchanged, but strengthened.

"Next to a good boiler, which governs the economy of fuel, the most important point in the construction of a locomotive engine (inasmuch as it most materially influences the cost of repairs) is to connect all the parts firmly together by a strong and well-arranged framing, so that they shall retain their relative positions when the engine is in motion, and that it shall receive and bear the strain, and the concussions to which every part is subject. The inside framing possesses a great superiority in this respect over the outside framing, as it forms a stronger and more direct connexion between the cylinder, the crank axle, and all the moving parts; and it bears all the strain of the engine, without throwing any portion of it on the boiler, as is the case with the outside framing.

"These advantages are best described by comparing it with the ordinary outside framing submitted to the principal strains which it has to resist.

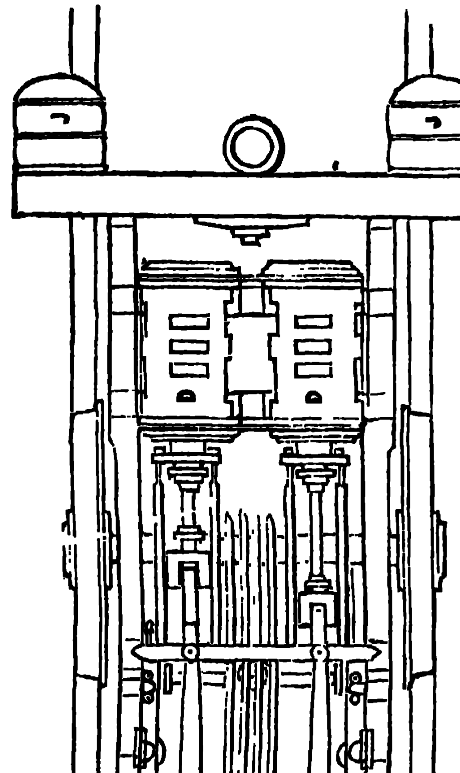
"The most important is that caused by the whole power of the engine acting as a direct strain upon the crank as it passes over either centre.

"With the inside framing the centre line of the connecting rod is only 10 inches distant from the centre line of the frame, and the total distance between the bearings is 43¼ inches; but where the framing is outside the wheels, these dimensions are necessarily 20 inches and 72 inches respectively, and the effects of the strain on the crank, in this case, would be, to its effect with the inside framing, as 14 is to 8.

"For this reason, when the principal frame is placed outside the wheels, it becomes necessary to have an additional inside framing, to prevent the fracture of the axle. These additional inside frames not only cause an increase of friction on the bearings of the cranked axle, but also throw a considerable strain on the boiler, which then becomes the medium of connexion between the inside and outside frames, the inside frames being fixed at one end to the bottom of the smoke-box, and at the other end to the fire-box, while the principal frame is attached, by long brackets, to the body of the boiler.

"The fact, that the use of four additional inside frames occasions six bearings on the axle, (that axle being only 6 feet long,) renders the system of principal outside framings so objectionable, that that circumstance alone should suffice to cause their rejection, for it is well known to practical men, that it is impossible to key so many bearings perfectly true, and to maintain them so, when the engine is working; and even if this precision were attained, the aggregate friction on the four inside, and the two outside bearings, would be much greater than when it is all thrown upon two bearings, because, in the first place, all the friction due to the weight of the boiler is borne by the two outside bearings alone, and that which results from the pressure of the steam, through the medium of the connecting rod, is thrown upon the four inside bearings; the pressure on the outside bearings is vertical, and the mean pressure on the inside bearings is nearly horizontal. So that, if instead of acting separately, these two amounts of pressure were thrown on the same bearings, the friction would only be due to the resultant of the pressures, and would, consequently, be much reduced.

Fig. 2.



"Another important feature is the strain to which locomotive engines are liable, from the pressing or striking of the flanges of the wheels against the rails when travelling on a curve.

"In engines with the bearings inside the wheels, the weight of the boiler has a tendency to bend the axle down in the centre, while the pressure of the flange against the rail acts upon it in a contrary direction, and thus one strain counteracts the effect of the other. If the bearing is outside the wheel, the weight of the boiler tends to bend the axle upwards, and a strain on the flange of the wheel acting in the same direction and in addition to it; when the breakage of an axle takes place, these joint actions tend to force the wheels under the engine, and there being no flange on the outside of the wheel to prevent it, the engine is thrown off the rails, which, it is evident, cannot happen with an engine having inside framing, because the weight of the bearings presses the flange of the wheel against the rail, and assists the length of the journal in keeping it from falling or being thrown off the rails.

"Several instances have occurred on the London and Birmingham Railway, when an axle has broken, that not only have the wheels remained on the rails, but the driver has been able to proceed with the train to the nearest station.

"The stiffness of the single inside framing is not only a remedy against the excessive wear and tear which are consequent on a less perfect union between the parts of the engine, but its simplicity allows the whole machinery to be arranged in a more compact form, and constructed with greater solidity, with this additional advantage, that the engine-driver, while standing on the foot-plate, can inspect the whole of the machine, and detect any derangement requiring his attention.

"It is evident that the round form of fire-box possesses great advantages over the square fire-box: first, it is much safer than the square fire-box, being made nearly in that shape which an excess of pressure beyond its stiffness would tend to bring it to, if made in any other form; moreover, the safety of the boiler with a square fire-box is nearly dependent on the strength, individually, of each of the stays which is fixed in it, (of which there are a great number;) whereas the pressure in the round fire-box is borne equally by the whole area of the plates of which it is composed: again, the corners in the square fire-box, in which the combustion is always languid, and consequently injurious, are avoided in the round fire-box.

"A lead plug is placed at the culminant point of the round fire-box, and will therefore melt before any other part is left dry, and, as the top row of tubes is placed two or three inches below the culminant point, it is almost certain that the extinction of the fire will prevent the

tubes being burnt; but, in a fire-box with a flat top, the melting of the lead would only occur when the whole surface was dry, and probably injured.

"It is admitted that a locomotive engine should be as light as is consistent with great strength, simple in its construction, composed of as few parts as possible, and that the greatest regard should be had to the diminution of friction; it is thence obvious that four wheels must be preferable to six, provided they carry the engine with the same steadiness.

"The use of six wheels originated, (as we have before shown,) in the necessity of supporting the large end heavy fire-box, which was not sufficiently balanced by the smoke-box end; but no such necessity can exist in the locomotives made according to the accompanying plan, as the weight is nearly equally distributed on the front and hind wheels, and not only would two additional wheels be useless, but they would be prejudicial and dangerous when the engines are travelling upon curves.

"A four-wheeled engine travelling upon a curve is driven, by the direct application of the moving power, towards the outside of the curve; but, as the wheels are rather conical, the large diameter of the cone will ride on the outside rail, while the smaller diameter of the opposite wheel will bear on the inside rail, and this difference, (as the outside rail is longer than the inside one,) will allow the wheels to revolve without slipping or grinding.

"With an engine upon six wheels, if the two leading wheels assumed this position, the others would necessarily be dragged after them; but a still more important point is, that the angle which the centre line of the locomotive forms with the tangent of the curve in which it is caused to move is much greater with six wheels than with four, so that the flange of the wheel presses more against the rail with the former than the latter engine.

"The pressure against the outside rail, arising from this cause, will be in direct proportion to the distance between the front and hind axle of either engine, so that it will be as 10 to 6.

"This pressure and consequent friction is still further increased by the action of the middle wheel, which tends to ride on the same curve as the front and hind wheels, but is prevented from doing so by being in a straight line between the two, and is thus forced to move laterally between the chord and the circumference of the curve.

"The friction arising from this lateral motion further presses the engine against the outside rail. Thus the four-wheeled locomotive has, in proportion, a greater weight on the front wheels, it presses less against the outside rail, and offers much less friction when travelling on curves; hence, it has less tendency to be thrown off the rails, it is more simple in its construction, less expensive in repairs on account of this simplicity, and the smaller cost of it fully justifies the directors of the several railways who have given the preference to this description of engine."

At the time the above paper was read before the Society, the four-wheeled engine had but few supporters, arising, no doubt, from the erroneous supposition, that the safety of the engine was in proportion to the number of wheels used.

It has, however, been steadily gaining ground in public estimation, and from the alterations going on in the construction of the six-wheeled engine, the advocates of them are evidently less confident in their superiority; and it is most gratifying to us that the advantages to be gained by the use of inside framing, which we then pointed out, are now tacitly admitted by our opponents of the greatest practical experience, who are gradually abandoning the outside frame.

As the inside frame becomes more and more general, the third pair of wheels will disappear, as not only useless, but really tending very materially to produce those accidents which they are supposed to guard against.

Indisputable proof has been furnished, that an engine with *inside framing* cannot come down by the breakage of an axle: an engine, therefore, is equally safe on that plan of construction whether on four, six, or eight wheels.

The advantages of four-wheeled engines, on our plan of construction, we maintain to be the following:

1st. The engine on four wheels is less costly than the one on six wheels; therefore to have the same number of engines, or the same power, on a line of railway, much less outlay of capital is required.

2nd. It allows the engine to be got into less space, consequently it is more compact, firmer, less likely to derangement, and much lighter.

3rd. Though the engine is lighter, the adhesion is more perfect from the weight on the driving wheels remaining nearly uniform, however unequal or out of level the rails may be; but in the engine with six wheels the adhesion is often imperfect (arising from the impossibility of mathematical precision in maintaining rails on the level,) although there may be fully as much weight on the driving wheels generally; that is, the fore and hind wheels sometimes carry the greatest part of the engine. When the driving wheels get into an uneven part of the road, and the constant action of the power of the engine is not resisted by the adhesion at these points, the driving wheels revolve without properly advancing the train, as every observant traveller knows; and all weight carried beyond what is necessary for adhesion on the rails, is an unprofitable load. There is much less of this in the four-wheeled than the six-wheeled engine, seeing that there is only one pair of wheels used for adhesion both in the four and six-wheeled engine, when used for passenger traffic; but, as the four-wheeled engine is lighter than the six-wheeled engine, there is less power required to take it up the inclines, and therefore more available power left applicable to the traction of the train.

4th. The engine is safer, as it adapts itself better to the rails, not being so likely to run off the line at curves or crossings.

5th. It is more economical in the working, requiring less fuel, there being also a less amount of depreciation, as there are fewer parts in motion, consequently, less friction, or wear and tear, and fewer parts to maintain; and even those are more easily got at, therefore much less expense is incurred in those repairs, which are common to both plans.

6th. The buildings, turn-tables, lathes, drills, smithies, and other costly conveniences necessary for the maintenance and repair of the engines, are not required on so large and extensive a scale, as the engine on four wheels is less in size than the one on six wheels.

7th. As the engine is more simple in its form and parts, there are fewer chances of delays, stoppages, and disappointments during the journeys or the times of taking the trains.

Whilst, therefore, those individuals, who have advocated the use of the six-wheeled engines are constantly changing their ideas, at one time adopting a large fire-box with the outside frame, and the addition of a third pair of wheels behind the heavy box to carry it; then changing to the small fire-box, with the third pair of wheels placed before it, and, subsequently, by the tardy adoption of the inside frame; we have been steadily persevering with our original plan, of engine on four wheels, which is now brought to a state of perfection for power and economy far beyond anything we could have expected. In proof of this, we can confidently refer to the London and Birmingham, the Eastern Counties, the Midland Counties, the North Union, the Lancaster and Preston, and the Manchester, Bolton, and Bury Railways, which are worked exclusively with the form of engine we have adhered to; and also to the Edinburgh and Glasgow, Glasgow and Ayr, and Runcorn Gap and St. Helen's, and several other lines which have in part adopted it.

In justice to ourselves we have thought it right to lay these remarks before the public, at the same time that we are quite ready to construct engines upon six, or any other number of wheels, freeing ourselves from the responsibility of the consequence of any other plan than our own; and only requesting that such of our friends and the public as may entrust their orders to us will permit us, at least for the safety of travellers, and our own credit, to adhere to inside framing.

BURY, CURTIS, AND KENNEDY.

*Description of Engravings.*

Fig. 1, is an elevation of the "Albert Engine;" fig. 2, a plan; A boiler; B fire-box; C Smoke-box, in which are placed the cylinders; D D cylinders, (valve-box, and valves removed;) E E driving-wheels; F F connecting rods; G crank axle; H H H H eccentrics for working valves; I I framing of engine; J buffers; K K safety-valves; L, starting and reversing handle; M steam cock for regulating speed; N N brass pumps for supplying boiler with water; O O pipes for conducting water from tender to pump; P P leather hose between engine and tender; Q Q bushes for axles; R R springs; S S guards for clearing rails.

## ON THE CONSTRUCTION AND USE OF COMMUTATION TABLES, FOR CALCULATING THE VALUES OF BENEFITS DEPENDING ON LIFE CONTINGENCIES.

### *Part* III.—*On the Present Values of the Simple Benefits.*

We propose in this paper to show how the present value of benefits may be deduced from the Commutation Tables. We must first explain what is meant by the present value of a benefit.

As regards the purchaser of a single benefit, it is seldom indeed that he will receive the precise value, (using the word in its ordinary sense) of what he has paid. In the case of certain kinds of benefits indeed, it is impossible that there should in any case be an exact compensation in this sense. For instance, if the benefit be an endowment, that is, a sum of money to be received in the event of the purchaser attaining a certain specified age; if he do not attain that age, neither he nor his representatives will receive anything, and consequently the money he has paid will be lost. On the other hand, if he do attain the specified age, the sum to be then received will be more than his payment would have amounted to, if it had been put out at interest at the time the bargain was made; else he would not have run the risk of losing it in the interval. In the case of such a benefit, therefore, the purchaser *must* be either a gainer or a loser. If the benefit consist of an annuity, the purchaser may live just such a period as that the number of payments he will receive will be exactly equivalent to the money he has paid. If he live a shorter time he will be a loser, and if a longer he will be a gainer. Similar remarks apply to the case of a life assurance. The purchaser may die, and the assurance be received, at the end of a period, the improvement of his premium or premiums during which would have produced an amount just equal to the assurance. But as it is much more likely that he will die either before or after the period of this equality, so the probability is proportionally greater that he or his representatives will be either gainers or losers.

But while there is this uncertainty in individual cases, there is, in a sufficiently numerous aggregation of cases, a regularity in the occurrences of the events on which the payments of benefits are usually made to depend, which admits of the calculation of the *average* values of those benefits to a very considerable degree of nicety. For, if we assume the mortality which will be experienced by a class of purchasers, sufficiently numerous to secure an average, to be the same as that indicated in the table which we take as our guide, (and which table presents the averages of a number of observations)—we say, making this assumption, it is evidently quite practicable to name the sum which will require to be contributed by the whole body of purchasers, to afford to each of them a benefit of a certain amount, on the occurrence of a specified contingency, the time, or the fact of this occurrence, or both, being uncertain, *in each individual case*. And this sum, divided by the number of purchasers, will be the amount which each ought to contribute, since all at the time of purchase are supposed to be equally likely to come into possession of the benefit. It is the last named amount, obtained in this manner, which is called the *present value*, or *single premium*, of the benefit to be purchased.

The meaning of the term present value might, perhaps, have been more briefly explained, by defining it as the sum which would be required from each of a large number of purchasers of benefits of the same kind, so that the seller should be in the end neither a gainer nor a loser.

We now proceed to the application of the tables. But first we remark, once for all, that in what follows we always suppose the *amount* of the benefit to be purchased, to be £1; except of course in the cases of an increasing annuity or assurance. In these we suppose that amount only, to which the purchaser becomes or may become first entitled, to be £1. When the present value of a benefit of £1 on any life is found, that of a similar benefit of any other amount, on the same life, will obviously be found by multiplying this present value, by the number of pounds in that amount.

Problem I. To find the present value of an endowment of £1; that is, of £1 to be received at the end of $n$ years provided $(x)$* be then alive.

* By this symbol is meant, and the phrase may in reading be substituted for it, "a life now aged $x$ years."

The number of individuals now alive, of the given age, according to the Mortality Table, is $l(x)$; and the survivors of these, at the end of $n$ years, is the number represented by the table to attain the age $x+n$, viz., $l(x+n)$. This number is consequently the number of pounds which will have to be paid at the end of $n$ years. But since money makes interest, the present value of this sum, or $l(x+n)v^n$, contributed now, will be sufficient to provide for the payment of the benefit. And since all now alive contribute equally, the amount to be contributed by each, that is, the required present value will be $\frac{l(x+n)v^n}{l(x)}$.*

To adapt this expression to the Commutation Tables, multiply the numerator and denominator by $v^x$, (which will not alter its value,) and it becomes

$$\frac{l(x+n)v^{x+n}}{l(x)v^x}$$

But the numerator of this expression is equal to $D(x+n)$, and the denominator to $D(x)$, by (1) and (3). Hence, the expression becomes finally, $\frac{D(x+n)}{D(x)}$.

From this general expression we obtain at once the solution of any particular case that may be proposed, by giving to $x$ and $n$ the proper values. Thus, if $x = 10$ and $n = 11$, that is, if the endowment is to be paid on (10) attaining the age of 21, the expression becomes

$$\frac{D(21)}{D(10)};$$

and the numerical solution is effected by taking the proper numbers from the table, and operating upon them as indicated by the formula.

If $n = 0$, that is, if the endowment is to be paid immediately, then we have, whatever the age may be,

$$\frac{D(x)}{D(x)} = 1, \text{ that is to £1,}$$

as we evidently ought to have.

Example 1. $x = 10, n = 11$.

$$\frac{D(21)}{D(10)} = \frac{3629\cdot2895}{6051\cdot0605} = \cdot59978 = 12s.$$

And if the amount to be received were £100, the present value would be

$$\cdot59978 \times 100 = 59\cdot978 = £59\ 19s.\ 7d.$$

Example 2. $x = 18, n = 6$.

$$\frac{D(24)}{D(18)} = \frac{3094\cdot1061}{4213\cdot8385} = \cdot73427 = 14s.\ 8d.$$

For £100 the present value would be $\cdot73427 \times 100 = 73\cdot427 = £73\ 8s.\ 6d.$

Problem II.—To find the present value of a life annuity of £1 on $(x)$.

This benefit consists of a series of payments of £1, to be made at the end of 1, 2, 3, &c., years, to the end of life. Its present value, therefore, will be the sum of the present values of the several payments. These present values are, by last problem,

$$\frac{D(x+1)}{D(x)},\ \frac{D(x+2)}{D(x)},\ \frac{D(x+3)}{D(x)}, \text{ and so on. And their sum is}$$

$$\frac{D(x+1) + D(x+2) + D(x+3) +, \&c.}{D(x)}, \text{ which by (1) is equal to}$$

$\frac{N(x)}{D(x)}$, which is therefore the present value required.

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* We have assumed above that the number of purchasers of endowments will be the number represented by the Mortality Table to be alive at the age at which the purchase is made. But the only assumption as to their number which it is *necessary* to make, is that this number will be sufficient to secure an average mortality proportional to that represented in the Table. If we had assumed any other number, we should have had to find by a proportion, the number of survivors at the advanced age. But by the assumption in the text, this operation is saved. In both cases the result would be the same. The value of a fraction depends, not on the *absolute magnitude* of its terms, but on their *relative magnitude*, or *ratio*. The value of $\frac{3}{4}$ths is the same as that of $\frac{6}{8}$ths or $\frac{9}{12}$ths, because the ratio of 3 to 4 is equal to that of 6 to 8, and 9 to 12.

The same remark will apply to the other benefits

Example 1. $x = 20.$

$$\frac{N(20)}{D(20)} = \frac{66048\cdot1809}{3818\cdot9594} = 17\cdot2948 = £17\ 5s.\ 11d.$$

Example 2. $x = 60.$

$$\frac{N(60)}{D(60)} = \frac{4068\cdot8483}{418\cdot5753} = 9\cdot7207 = £9\ 14s.\ 5d.$$

If the annuity be *due*, that is, if the first payment is to be made immediately, then, the present value of that payment, that is, $\frac{D(x)}{D(x)}$, must be added to the above expression, which then becomes,

$$\frac{D(x) + N(x)}{D(x)} = \frac{N(x-1)}{D(x)}. \quad (10.)$$

The same result is obtained by commencing the summation of the series in the numerator of the first expression a year earlier, that is, with $D(x)$, instead of $D(x+1)$.

Example.—Required the present value of an annuity *due* of £1 on (20); that is, $x = 20$.

$$\frac{N(19)}{D(20)} = \frac{69867\cdot1403}{3818\cdot9594} = 18\cdot2948 = £18\ 5s.\ 11d.$$

Problem III.—To find the present value of an annuity of £1 deferred for $n$ years, on $(x)$.

This benefit consists of a series of payments of £1, to be made $n+1$, $n+2$, $n+3$, &c., years hence, to the end of life; and its present value will, therefore, be the sum of the present values of these payments. These present values are found by Problem I., and their sum is,

$$\frac{D(x+n+1) + D(x+n+2) + D(x+n+3) + \&c.}{D(x)}$$

which by (4) is equal to $\frac{N(x+n)}{D(x)}$, and this is, therefore, the present value required.

Example.—If $x = 20$, and $n = 10$ that is, if the annuity is to be entered upon by a person now aged 20, when he attains the age of 30, its present value will be,

$$\frac{N(30)}{D(20)} = \frac{37124\cdot4288}{3818\cdot9594} = 9\cdot7211 = £9\ 14s.\ 5d.$$

If the first payment is to be made $n$ years hence, the requisite change will be made in the formula, as in last problem, by writing $x-1$ for $x$, in the numerator. The expression for the present value in this case, therefore, will be

$$\frac{N(x+n-1)}{D(x)};$$

which is also, as it evidently ought to be, the expression for the present value of an annuity deferred for $n-1$ years.

If, in the expression $\frac{N(x+n)}{D(x)}$, we suppose $n$, the period of deferment, equal to 0, that is, that the annuity is to be entered upon immediately, the expression becomes $\frac{N(x)}{D(x)}$, the same as in last problem; which problem is, therefore, but a particular case of the present. And the following rule will apply to both:—

Divide the number in column N, opposite the age at which the annuity is to be entered upon, by the number in column D opposite the present age: the quotient will be the present value of the annuity.

A similar remark will apply to the other benefits, and a corresponding rule for all of them might be formed. But, as our space is limited, the present intimation must suffice.

Problem IV.—To find the present value of a temporary annuity of £1 for the next $n$ years, on $(x)$.

This benefit consists of $n$ payments of £1 to be made at the end of 1, 2, 3, .... $n$, years, if $x$ be then alive. The present values of these payments are,

$$\frac{D(x+1)}{D(x)},\ \frac{D(x+2)}{D(x)},\ \frac{D(x+3)}{D(x)},\ \ldots\ \frac{D(x+n)}{D(x)};$$ the sum of which is

$\dfrac{D(x+1)+D(x+2)+D(x+3)+\ldots D(x+n)}{D(x)}$. And this, by (6.) is equal to $\dfrac{N(x)-N(x+n)}{D(x)}$, which is, therefore, the present value of the annuity.

This formula might also have been deduced by subtracting from the present value of an annuity for the whole life, that of an annuity deferred for $n$ years, since the present value of an annuity during the next $n$ years, and that of an annuity to commence at the end of $n$ years, are evidently together equal to the present value of an annuity for the whole life. Thus, the present value of the life annuity is, (Prob. II.,)

$$\frac{N(x)}{D(x)},$$

and that of the deferred annuity is, (Prob. III.,)

$$\frac{N(x+n)}{D(x)}.$$

Their difference, or $\dfrac{N(x)-N(x+n)}{D(x)}$, is the present value of the temporary annuity, as before.

Example.—Required the present value of an annuity of £1 during the next 10 years, on (20.)

$$\text{Ans. } \frac{N(20)-N(30)}{D(20)}=\frac{66048\cdot1809-37124\cdot4288}{3818\cdot9594}=\frac{28923\cdot7521}{3818\cdot9594}=7\cdot5737=$$
£7 11*s*. 6*d*.

If this be added to 9·7211, which we found by last problem to be the value of an annuity deferred for ten years, on a life of the same age, the sum 17·2948 will be the value of an annuity on the whole life; and it corresponds with the value which we deduced for that age by problem II.

Here we may repeat, once for all, as the remark applies equally to the expressions for all the benefits, that so long as the payments continue the same in number, if they commence a year earlier than we have supposed, the change requisite to be made in the formula, is the substitution of $x-1$ for $x$ in the numerator. The above expression thus becomes

$$\frac{N(x-1)-N(x+n-1)}{D(x)}$$

Problem V. To find the present value of a deferred temporary annuity of £1 on ($x$), the period of deferment being $k$ years, and that of continuance $n$ years.

This benefit consists of $n$ payments of £1, to be made at the end of $k+1$, $k+2$, $k+3$, .... $k+n$ years. The present values of the payments, are, (Prob. 1.)

$$\frac{D(x+k+1)}{D(x)},\ \frac{D(x+k+2)}{D(x)},\ \ldots\ldots\ \frac{D(x+k+n)}{D(x)};$$

And the sum of these expressions is,

$$\frac{D(x+k+1)+D(x+k+2)+\ldots\ldots D(x+k+n)}{D(x)},$$

which by (8) is equal to

$$\frac{N(x+k)-N(x+k+n)}{D(x)}.$$

And this is evidently the present value required.

It will be seen that this expression may be derived from that in the last problem, by changing $x$ into $x+k$ or $n$ into $k+n$ in the numerator.

Example. Required the present value of an annuity of £1 on (20), to be entered upon 10 years hence, and to continue 10 years.

Here $x=20$, $k=10$, and $n=10$.

$$\frac{N(30)-N(40)}{D(20)}=\frac{37124\cdot4288-19964\cdot4836}{3818\cdot9594}=\frac{17159\cdot9452}{3818\cdot9594}=4\cdot4934=£4\ 9s.\ 10d.$$

Problem VI. To find the value of a life annuity on ($x$) of which the first payment is to be £1; the 2nd, £2; the 3rd, £3, and so on, increasing an-

nually, by the amount of the first payment, to the end of life.

This benefit may be conceived to consist of a series of annuities of £1, of which the first is to be entered upon now, the 2nd, one year hence; the 3rd, two years hence, and so on, an additional annuity being entered upon every year, till the end of life. The present values of these annuities are, by Problems II. and III.,

$$\frac{N(x)}{D(x)}, \quad \frac{N(x+1)}{D(x)}, \quad \frac{N(x+2)}{D(x)} \quad \&c.;$$

and the sum of these expressions, which will be the required present value, is, by (2),

$$\frac{N(x) + N(x+1) + N(x+2) + \&c.}{D(x)} = \frac{S(x)}{D(x)}$$

The same result will be obtained by viewing the benefit in another light. Thus, the first payment is £1 to be received a year hence; its present value, therefore, is $\frac{D(x+1)}{D(x)}$. The second payment is £2, to be received two years hence; its present value, therefore, is, $\frac{2\,D(x+2)}{D(x)}$. In like manner, the present values of the 3d, 4th, &c., payments will be respectively,

$$\frac{3\,D(x+3)}{D(x)}, \quad \frac{4\,D(x+4)}{D(x)}, \quad \&c.$$

And the sum of these expressions, which will be the present value of the benefit, is, by (11),

$$\frac{S(x)}{D(x)}, \text{ as before.}$$

Example. Required the present value of an increasing annuity of £1, £2, £3, &c., on (30)?

$$\text{Answer, } \frac{S(30)}{D(30)} = \frac{539239\cdot0044}{2257\cdot6521} = 238\cdot8494 = £238\ 17s.$$

Problem VII. To find the present value of a deferred increasing annuity on $(x)$, that is, if an annuity to be entered upon $n$ years hence, and whose first payment is to be £1, the second £2, the third £3, and so on, increasing every year, by the amount of the first payment, to the end of life.

This benefit may be considered as a series of deferred annuities of £1, of which the first is to be entered upon $n$ years hence, the second $n+1$ years hence, the third $n+2$ years hence, and so on, an additional annuity being entered upon every year, till the end of life. The present values of these annuities are, by Problem III.,

$$\frac{N(x+n)}{D(x)}, \quad \frac{N(x+n+1)}{D(x)}, \quad \frac{N(x+n+2)}{D(x)}$$

and so on. And the sum of these expressions, which will be the present value required, will be, by (4)

$$\frac{S(x+n)}{D(x)}$$

Example. An annuity, whose successive payments are to be £1, £2, £3, &c., is to be entered upon by (20), 10 years hence; that is, when he attains the age of 30. Required its present value?

$$\text{Answer, } \frac{S(30)}{D(20)} = \frac{539239\cdot0044}{3818\cdot9594} = 141\cdot2005 = £141\ 4s.$$

Problem VIII. To find the present value of a temporary increasing annuity, for $n$ years, on $(x)$, the first payment being £1, the second £2, and so on, increasing each year, by the amount of the first payment, till the end of the term, when all payments cease.

This benefit consists of a series of temporary annuities of £1, of which the first is to be entered upon now, to continue $n$ years, and then to cease; the second is to be entered upon one year hence, to continue $n-1$ years, and then to cease; and so on to the $n$th annuity, which will be entered upon $n-1$ years hence, continue one year, and then cease; that is, will make but a single payment.

Now the present values of these annuities, are [omitting, for perspicuity, the common divisor $D(x)$] by Problems IV. and V.,

| | |
|---|---|
| Of the 1st | $N(x) - N(x+n)$ |
| 2nd | $N(x+1) - N(x+n)$ |
| 3rd | $N(x+2) - N(x+n)$ |
| .... | ............. |
| Of the $(n)$th | $N(x+n-1) - N(x+n)$ |

The sum of these is, (7),

$$S(x) - S(x+n) - nN(x+n);$$

and, restoring the divisor, we have for the required present value,

$$\frac{S(x) - S(x+n) - nN(x+n)}{D(x)}.$$

Example. Required the present value of an increasing annuity of £1, £2, £3, &c., on (55) for the next 10 years.

$$\text{Answer, } \frac{S(55) - S(65) - 10\,N(65)}{D(55)} = \frac{60976{\cdot}4989 - (17008{\cdot}1044 + 23769{\cdot}292)}{587{\cdot}3514}$$

$$= \frac{20199{\cdot}1025}{587.3514} = 34{\cdot}390 = £34\ 7s.\ 10d.$$

Problem IX. To find the present value of an arrested increasing annuity on $(x)$; that is, of an annuity whose successive payments are to be £1, £2, £3, and so on, increasing £1 every year till $n$ payments have been made, the $n$th payment being thus £$n$, which is also to be the amount of each subsequent payment till the end of life.

The difference between this benefit and that which formed the subject of the last problem is, that while, in the case of the benefit referred to, all payments were to cease at the end of $n$ years, in the present case the increase only is arrested, and the annuity continues to pay £$n$ a year during the remainder of life. If, therefore, to the present value of the benefit in the last problem, we add the present value of an annuity of £$n$, deferred for $n$ years, the sum will be the present value required.

$$\text{That is, } \frac{S(x) - S(x+n) - nN(x+n)}{D(x)} + \frac{nN(x+n)}{D(x)} = \frac{S(x) - S(x+n)}{D(x)}.$$

Example. Required the present value of an annuity of £1, £2, &c., on (55), the increase of which is to be arrested after 10 years?

$$\text{Answer, } \frac{S(55) - S(65)}{D(55)} = \frac{60976{\cdot}4989 - 17008{\cdot}1044}{587{\cdot}3514} = \frac{43968{\cdot}3945}{587{\cdot}3514}$$

$$= 71{\cdot}8589 = £74\ 17s.\ 2d.$$

The length to which the present paper has extended warns us to draw to a close. We must, therefore, reserve for our next paper the consideration of the assurance benefits, and, if space permit, also of a few compound benefits.

G.

Hermes-street, Pentonville.

SCREW PROPELLING—MR. LOWE'S CLAIMS.

Sir,—A subject which is now occupying the minds of all scientific nautical men, is the application of a propeller to steam-vessels, which shall possess both speed and security. The Government is giving its attention to the matter, and doubtless in our war-steamers, to have the propeller out of the reach of an enemy's fire, and the ship under perfect command, are points of paramount importance.

My object in inviting your attention to the subject as a public journalist, is to solicit a small space in your valuable Magazine, to set the history of the *screw*-propeller in a correct point of view, and to disabuse the public mind of certain impressions which have been promulgated from sinister and disingenuous motives. I am the more induced to do so, as a work on the subject has just issued from the press, entitled, "Appendix D,

on the Archimedean Screw, or Submarine Propeller," by Elijah Galloway, 1842, which purports to be a history of the screw propeller; and which, from some circumstance, which I will not designate, omits all notice of my propeller, consisting of the *segments of a screw*, though it is the *only one* which will accomplish any required speed, and perfect security.

The hope of setting my case before the public, is the occasion of my trespassing on your valuable columns, being assured that your acknowledged liberality, and great regard for equity and fair dealing, will induce you to lend me assistance to assert the justice of my cause over the many pretenders and usurpers of my patent right.

With this view, I have thrown hastily together a few facts in connexion with the history of the screw-propeller.

In the year 1817, there were but four steam-boats on the river Thames, namely, the *London Engineer*, the *Father Thames*, the *Richmond*, and the *Hope*; the last was the first vessel to which the screw was ever applied. It was fitted with a *whole* screw, and failed.

In the year 1826, Messrs. Shorter and Lowe, fixed to the bows of the *Royal George* barge, owned by the Goldsmiths' Company, two *parts* of a screw, in the form of curved blades. An experiment was made, and this also failed.

In 1834, I produced a model with two blades or segments of a screw, to be placed at the stern of a vessel, which, upon trial, was found to perform well.

In 1836, I became acquainted with a Mr. Joseph J. Oddy Taylor, who was shown the model I had made in 1834, and he entered into a *written* agreement with me not to take any undue advantage, or deprive me of the benefits of my invention. I made a second model for Mr. Taylor, but for two years, the taking out of a patent was delayed. In 1838, I was informed that Mr. Taylor was about to take out a patent for a propeller upon my model, when, to secure my right, I entered a caveat at the proper offices. Soon after, Mr. Taylor did actually make application for a patent, and an appointment having been made for hearing my grounds of opposition to it, I met him at the office of the Attorney-General, Sir John Campbell, who heard the statements of both parties. I produced the agreement signed by Mr. Joseph J. Oddy Taylor, and also claimed the model produced by him as being the one made by my own hands. Sir John then asked Mr. Taylor, if he admitted his handwriting to the agreement, when he said, he did; upon which Sir John immediately decided in my favour. A patent was then taken out by me, and the specification was completed, and bears date, 24th March, 1838.

Since that period, my patent has been the sport and plunder of all sorts of pirates. While none have dared to dispute my patent right, some have tried by colourable variations to evade it; others again have boldly applied my segments of a screw, without any variation whatever, and openly set me at defiance, knowing that to a man of my limited means the entanglement of the law would be, as it has been in my case, a denial of justice.

In the autumn of 1838, I fitted my patent propeller, composed of the segments of a screw, to a boat named the *Wizard*, and made trial of her, having on board Mr. Francis Pettit Smith, the inventor(?) of the Archimedes, or *whole* screw, and Mr. Wimshurst. We started from Deptford pier to Mr. Wimshurst's yard, and the result of the trip was pronounced to be successful. *This was at the time Mr. Wimshurst had the* Archimedes *on the stocks.*

After this time, a vessel with my patent segments was worked in the Thames, above and below bridge, about October, 1838, with a party of gentlemen on board, and found completely to answer every expectation. Among these gentlemen I may mention the names of Mr. Anderson, Mr. Cox, and Mr. Soaper, of the Central Coast of America Company.

Since my patent was granted there have been several others taken out, which are all, more or less, infringements of mine.

The first of these was Mr. J. J. O. Taylor, who has never, however, acted upon it. Then came a boat by Capt. Carpenter, R.N., and worked by hand-labour, but that did not succeed.* After this, a patent was taken out by Capt. George Smith, R.N., who has admitted

* A great mistake, as Mr. Lowe will see, by referring to Mech. Mag., No. 976, p. 329; and No. 978, p. 364.—Ed. M. M.

to me that his invention was similar to mine; and I must acknowledge, to his honour as a gentleman, that he has never attempted to carry out his patent. Another screw propeller was brought out by a Mr. Hunt, and patented in that name, which came so palpably from my patent segments, that none but experiments have ever been attempted by it.* The next patent granted was to Mr. Blaxland, whose specification is expressed in terms so closely resembling mine, that the description reads as if it had had mine for the groundwork.

I have thus briefly alluded to the history of the screw propeller, as applicable to my segments. There are other propellers invented, as Fyfes', Rennie's, Napier's; but it is needless to refer to all.

I have already trespassed too far on your courtesy, to enter at length into the proceedings of the "Ship Propeller Company," under the management of Mr. F. Pettit Smith; but there are one or two statements put forth in their prospectus which I cannot forbear briefly noticing. The prospectus alleges that "the *Archimedes* steam-boat has proved the superiority of Mr. Smith's Patent Screw Propeller;" whereas, any success attending the *Archimedes* was gained when my patent segments were applied, instead of Mr. Smith's *whole* screw. The voyage across the Bay of Biscay, from Plymouth to Oporto, so boastingly referred to, was performed by a propeller of my segments. The *Archimedes* left port with Mr. Smith's patent, which was afterwards unshipped, and my patent segments fitted on, with which she performed the voyage, as the testimony of the "gentlemen who freighted her" will prove. On her return she got foul of the "Goodwins," and was obliged to come back to the Thames with my propeller still fixed to her stern. Another statement made by the Company is, that the *whole* of the patents have been purchased by them, which is not true. My patent remains in my own right and possession; and what the Company could *not* purchase, they have been unscrupulous enough to appropriate without leave or license.

I desire no favour beyond my right; and if my submarine propeller be deficient in producing the two most essential requisites for a propeller to possess, viz., security and speed, then I should expect it to fall into deserved neglect.

There may be some merit in producing a valuable appendage to the power of steam, (which has cost me many years of labour and expense,) and my ambition may be gratified at the success of my ingenuity; but there should be some more solid advantages accruing to me, in the shape of a fair recompense.

Your giving publicity to this account may form the first step towards vindicating my right; and, trusting the day of retribution will not now be long delayed,

I remain, Sir,
With great respect,
Your most obedient humble servant,
JAMES LOWE.

October 24, 1842.

* Here, again, we must say, Mr. Lowe is greatly in error. Mr. Hunt's patent is for the combination of a steering and propelling apparatus in one; and he expressly states, that he lays no claim to any particular sort of propelling blade.—Ed. M. M.

## THE GREAT BRITAIN—IRON PLANKING.

Sir,—Having resided near Bristol, during the time that the principal portion of the outward sheeting of the hull of the then *Mammoth*, now *Great Britain*, was being laid on, it struck me very forcibly, that the method adopted, that of riveting together oblong sheets of iron, of short lengths, was a most clumsy mode of proceeding, and utterly unworthy of the advanced state to which the mechanical arts have arrived; and I should have communicated to you my views on the subject long ago, had I not expected that the remedy, which seemed so obvious to me, must, ere this, have occurred to others more interested in its adoption, and provided with the machinery necessary to carry it out. As that, however, appears not to have been the case, I shall at once state my plan, which is to substitute for the iron sheets now used, what may be termed "*Iron Plank.*" I would have the iron intended for ship-building, (and for divers other purposes as well) rolled out into slips of a length and breadth suitable to the purposes to which they will have to be applied, and for large ships I would say the longer the better. There can be no difficulty in the thing, as the requisite machinery attached to a powerful rolling mill will readily present itself to the mind of any intelligent mechanic.

By adopting this plan not only will the numerous heading-joints (a sure source of weakness) of the present method be avoided, but the material itself will be, I conceive, considerably increased in toughness of fibre, as small wires are stronger in proportion than large ones. The planks should (I think) be annealed after rolling. Ships constructed with Iron Planking, well put together, (especially if the joints can be fused firmly together, of which, from Mr. Spencer's experiments, there can be little doubt,) would, I conceive, be almost invulnerable, and perhaps had the ill-fated *Brigand* been so built, she would have been afloat at this hour.

Should you think this invention, (if, indeed, invention it can be called,) worth communicating, you will do me the favour to insert it in your very useful Magazine, and so oblige your obedient servant,

JOHN DAYMAN.

Mambury, Bideford, Devon, November 11, 1842.

[The correspondence mentioned in P.S. to Mr. Dayman's letter, we shall be glad to receive.—ED. M. M.]

## IMPROVEMENT IN THE CONSTRUCTION OF CISTERNS.

Sir,—The remarks of Mr. Cole in a recent Number of your Magazine on the defects of our water cisterns, will no doubt draw the attention of ingenious men to the best means for their removal, which may eventually lead to the introduction of some important improvements in these articles.

In the mean time, I beg to offer a few remarks illustrative of the inattention hitherto paid to this matter, and to suggest a simple alteration of form, which would greatly increase the facility of cleansing, when this process is, as at times it always will be, absolutely necessary.

Fig. 1.

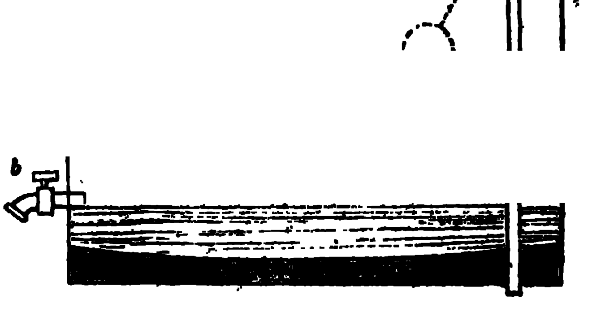



Fig. 1, is a rough sketch of the manner in which cisterns are usually constructed; *a* is the supply pipe and ball-cock; *b* the service pipe, or tap, fixed in the side of the cistern a few inches above the bottom; *c* the waste pipe, the plug-socket of which closes an aperture in the bottom of the cistern. The principle aimed at in this mode of construction has been, to allow all the ponderable impurities to become deposited at the base of the cistern, below the point at which the supply of water for domestic purposes is drawn off; the accumulated impurities being got rid of, by withdrawing the waste pipe. It unfortunately happens, however, that the object in view is often lost sight of by the cistern maker, who makes them in this manner, because he was taught so to do during his apprenticeship, and not because he comprehends the principle. In the greater number of instances it will be found, that the waste-pipe socket is soldered into its place in such a manner, that there is a *considerable rise* all round the opening, which ought to be, on the contrary, *the lowest part of the cistern.* Again, from want of care in the fixing, it will often be found that there is a fall away from, instead of towards this opening. In several cisterns I have noticed an elevation in the middle and a fall towards both ends. In all these cases it becomes a very troublesome, and a very difficult matter to effect the perfect cleansing of the cistern, as the water cannot all be run off: the impurities settle in the lowest parts, and fresh quantities of water thrown in, dilute but do not entirely remove them.

Fig. 2.

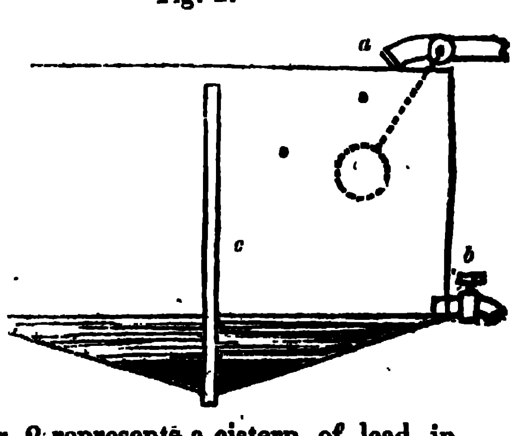



Fig. 2 represents a cistern of lead, in which the base inclines from all the sides towards the centre, where the waste pipe is inserted. The bottom of this cistern

may be either of a prismatic or conical form; in either case, all the impurities will settle around the waste wipe and be carried off by the rush of water towards the opening, whenever the waste pipe is withdrawn, and any further quantity of water thrown in will cleanse the cistern of every impurity. In the present form of cistern (fig. 1,) the escape of the water is sluggish; in the form suggested (Fig. 2,) its escape would be exceedingly rapid.

Fig. 3.

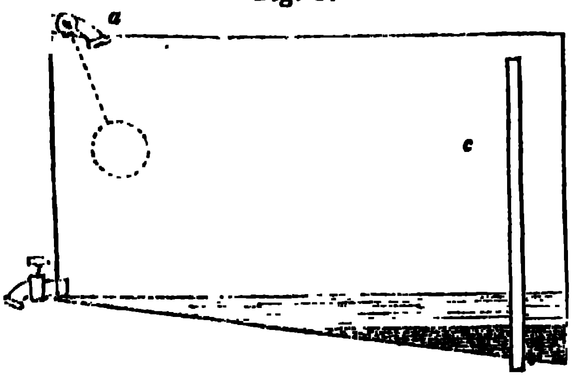



Fig. 3 exemplifies this principle as it might be advantageously applied to cisterns of slate. In this material, the bottom may be flat, but it should be made to incline from three of the corners towards the fourth, where the waste-pipe should be inserted. It is a very common practice to put up slate cisterns without any waste-pipe at all, but this is decidedly bad, because however cleanly the material of the cistern, impurities will in the course of time become deposited therein and must be removed.

In each of these cases it will be seen that the principle of drawing the supply of water from above the lower strata, is equally carried out, with this advantage, that if the cistern is emptied to this level the remaining quantity of unchanged water is a minimum.

I am, Sir, yours respectfully,

Wm. Baddeley.

Hamburgh, November 1st, 1842.

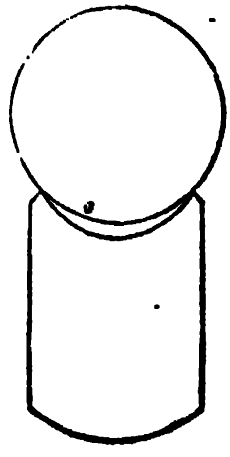
## DESCRIPTION OF THE MESSRS. JOSEPH WHITWORTH AND CO.'S PATENT GUIDE SCREW STOCK.

(Communicated by the Inventors.)

The Guide Stock is entirely new in principle, and will cut a screw scarcely inferior to that obtained in a slide lathe from a true guide. The name has been chosen from this circumstance, as expressing the peculiar feature of the invention. The thread produced is not only true, and of the exact pitch required, but perfectly formed throughout, being cut clean without distortion of the metal.

In all these respects the advantage of the Guide over the common Stock is remarkable. The latter, it is well known, will not cut a screw in any degree perfect. The thread, besides being irregular, is never of the right pitch. It is also more or less swollen by the violence done to the metal, so that the diameter of the screw is often considerably greater than that of the blank shaft on which it is cut. These defects are attended with the most serious practical inconvenience. They often render it extremely difficult to obtain a fit between the screw and nut, and consequently occasion a considerable sacrifice of time and labour. They necessarily impair in a very great degree the efficiency of the screw bolt, which cannot possess either the strength or mechanical power which it would have if the thread were cut true and clean.

The defects in question are variously modified according to the size of the master tap used in cutting the dies. If they have been cut by a master tap double the depth of the thread larger in diameter than the shaft to be screwed, they will act very well at first, and the thread will be started true, but as the operation proceeds, they become altogether unsteady and uncertain in their action. If, on the other hand, they have been cut by a master tap of the same size as the shaft to be screwed, the thread is made untrue in its origin. They first touch the shaft only on the extreme points of their outer edges, as shown in the following sketch.



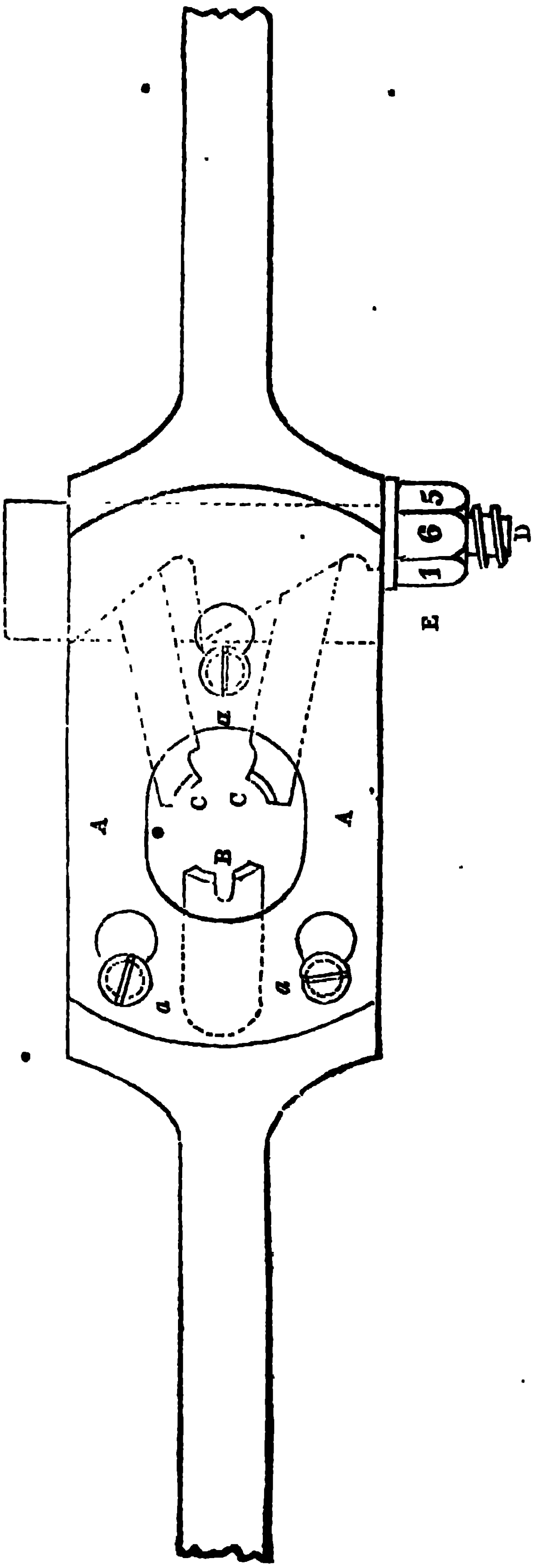
They have neither sufficient guide nor steady abutment, till the operation is on the point of being completed. It is not unusual to employ a master tap of an intermediate size. In this case, however, it is obvious the dies will combine, in a modified degree, the defects peculiar to each of the cases before mentioned.

In the Guide Stock this perplexity is entirely obviated, and the dies act with full advantage from the commencement of the operation to the conclusion. They are cut by a master tap double the depth of the thread larger than the screw blank; while their general form and the direction in which they are moved forward, are such as to preserve their cutting power, and steadiness of action undiminished to the full depth of the thread.

The plan of the Guide Stock will be readily understood from the engraving opposite. A, the top plate, fastened by screws *a a a*; B, a stationary die; C C, moving dies; D, a sliding piece with inclined slides for moving the dies; E, a nut for drawing up the piece D. The interior of the stock is shown by dotted lines through the top plate A.—B is a stationary die, C C are moving dies, brought up by a piece D, sliding in a recess in the stock, and bearing with a distinct incline against the back of each die. The piece D is drawn up by a nut E, on the outside of the stock.

The dies having been cut by a full-sized master tap, as before mentioned, the curve made by their outer edges is that of the blank shaft they are intended to screw. Hence, in starting the thread, they bear at all points of the common curve, and the impression made by indentation is the exact copy of the thread of the die. The parts indented serve as a steady guide to the dies, in cutting round the blank shaft. A groove in the stationary die facilitates the operation. Four cutting edges are brought into action, at points of the circumference nearly equidistant, so that by little more than a quarter turn, the thread is completely started round the shaft. The difficulty involved in the operation by the common stock is entirely removed.

After starting the thread, the stationary die serves principally as a guide and abutment for the others. The moving dies are peculiar in their form and direction, both peculiarities depending on the position of the arc in the shank of the die. The two sides have each a different inclination to the arc. As the die moves forward, one side becomes prominent towards the screw shaft, and its cutting




edge contines in contact with the thread, till it is formed to the full depth required.

The prominent sides of the moving dies are those turned towards each other.

The direction of the common die is necessarily towards the axis of the screw shaft. In the Guide Stock the direction of the moving dies is that of two planes, meeting beyond the centre of the stock, in a line parallel to the axis of the screw shaft, and considerably behind it. This direction is determined by reference to the change which takes place in the relative position of the screw shaft, as the thread is cut deeper. One of the three dies being stationary, there must necessarily be a constant change in the position of the screw shaft in relation to the two others, the effect of which, if not counteracted, would be to deprive the cutting edges of the requisite prominence. By giving them the direction before mentioned, the proper degree of prominence is secured, notwithstanding the change of position. The latter, when combined with the eccentricity of the dies, so far from being any impediment to their action, materially assists it. The newly-formed thread is thereby kept in contact with the dies, for some distance behind their cutting edges, affording them the same kind of support throughout the operation which they have at its commencement, when, as before observed, the curve made by their outer edges is coincident with that of the screw blank. This continued support, which is necessary to steady their action, could not be obtained without a change in the position of the screw shaft. They would otherwise acquire too much clearance as they form the thread deeper, and their cutting edges would be apt to dig.

The steadiness of the Guide Stock, and its easy action in screwing, are equally remarkable. In using it, not one-half the force consumed by the common stock is required. The inner edges of the moving dies (which principally act in cutting out the metal) are filed off to an acute angle. This enables them to cut with extreme ease, and without in any degree distorting the thread, while they take off shavings similar to those cut in a lathe. Their action in cutting is in effect the same as that of a chasing tool, to which they bear an obvious resemblance in form. They may also be sharpened on a grindstone in the same manner.

A practical difficulty has hitherto attended the use of the Screw Stock, arising from the wear of the taps and dies. The tap becomes less in diameter, and consequently taps the hole too small, while the opposite effect takes place with the dies, which, being unable to cut a full-sized thread, leave the screw too large. The only mode of counteracting this twofold error, so as to obtain a fit between the screw and nut, is by forcing the dies forward till they have reduced the diameter of the screw a proportionate quantity. From what has been before observed, it is evident that this cannot be done in the case of common dies, without injury to the thread. In using the Guide Stock, on the contrary, it is attended with no disadvantage. Lest the diameter of the screw should be inadvertently reduced more than necessary, figures are stamped on the sides of the set nut E, to indicate when the thread is full.

### PROGRESS OF WOOD PAVING.

Sir,—In a notice of a work by Colonel Maccrone—"Hints to Paviors"—prefaced by some remarks of your own, which appeared in the *Monthly Repository* of December, 1833, and, if I recollect, continued in January, 1834, I expressed an opinion that the success of wood paving was very doubtful, for several reasons, viz.:—

That it would swell in winter, and shrink in summer.

That it would be liable to rot and generate miasma.

That it would be liable to be stolen for fuel, like farmers' fences.

These opinions were grounded on the assumption that deep blocks of wood, of hexagon form, with the grain vertical—the original proposition—were to be used, not merely in leading thoroughfares, but generally, in all districts.

Nearly eight years have elapsed since that time, and wood paving has become general in many leading thoroughfares; and there can be no doubt of its increase, for the following reasons.

1. Houses increase in value in thoroughfares of great traffic, inasmuch that, noise and concussion being diminished—almost removed—they are more available as dwellings: in technical phraseology, "shopkeepers can let their lodgings."

2. The great diminution in wear and tear of horses and vehicles.

3. Greatly increased cleanliness.

Even supposing the expense of maintenance of the pavement to be greater, the great economy induced in other ways is a compensation of manifold amount.

The alleged drawback on the wooden pavement is, the slipping of the horses. This is of little importance, inasmuch as, when the lines are completed, there will be little wear of horse-shoes; and they can be made cross-cut, like a coarse file, and thus produce adhesion. Apart from this, sharp river sand spread upon the surface, from time to time, will materially lessen the evil; and, moreover, horses will learn, like bipeds, to tread securely.

With regard to my expressed opinion as to the *swelling* of the timber, it has been proved to be an evil in the blocks with vertical grain, in that portion laid near St. Giles's church. It rose occasionally in large swelling patches, and occasionally forced up the side pavements. Summer *shrinking* never takes place, because the artificial watering prevents it. I omitted this element in my calculation.

But an alteration has taken place in the mode of laying down. The most approved mode now is, with the grain of the wood at an angle of 45° with the surface of the road. This prevents the swelling of the wood from acting as a lateral wedge, and developes the elasticity usefully, in preventing the effects of concussion. A piece of wood paving may be regarded as a bundle of quills tied up together. Laterally, they have great elasticity; end-ways, none. The bundle of quills may be trodden on without crushing, but the single quill will be crushed under the foot. Upon this principle, wooden pavements, in which the quantity of timber is stinted, will fail, while the larger mass will be successful. It must be obvious, that the most perfect developement of the elastic action of the timber will be with the grain parallel to the surface of the road; and the least perfect, at right angles with the surface of the road. But the grain parallel to the road would involve the evil of separation of the fibre, by stripping off in wear; and the most successful general result is, with the grain at an angle of 45° with the surface of the road.

With regard to my opinion as to the liability of the wood pavement to rot and generate miasma, I omitted to take into account, that stagnation is a needful element in generating fungus, or rot. In the main thoroughfares no stagnation can exist, for they are never quiet; but I have no doubt that, if the dull streets of the West End were lined with deep blocks of vertical grain, and never watered, the result would be, swelling in winter, shrinking in summer, and the generation of nuisance by rotting. On railways, the rails in constant use do not rust—those out of use rust rapidly. And, if laid in by streets and lanes unwatched by the police, the poor would assuredly regard wood pavement as a fuel quarry, as report says the grave-diggers regard coffins in the London burying-grounds.

The rationale of the matter is this. A road, whether bordered by houses or not, requires to be constructed of a certain strength of material proportioned to the traffic, and, if sufficiently strong, would last for ever, but for the destruction of the surface by continual friction, *i. e.*, if no underground agencies, such as water, &c., be at work. To prevent destruction of the surface a tyre is required, which may be renewed as it wears away, precisely like a wheel; and wooden tyre is the best surface for a road, being in sufficient masses not to be crushed by the passing loads.

The practice now obtaining, of intersecting the wood pavement by channels, to give the horses foot-hold, is most mischievous, and will diminish the durability nearly one-half. A system of blows is kept up between the wheels and the wood. It would be far better to make a plain surface, and sand it frequently. Nor must it be forgotten, that the draught on the intersected wood is much increased.

To conclude: I judge that the problem is still to solve between wood pavements and tram ways. The draught on an iron rail is far less than on any wood whatever. A perfectly hard and true circle running on a perfectly hard plane, with a wood understruction, is the point to aim at, to produce the minimum of draught and the maximum of durability; all else is never ending, still beginning, drudging and repair. Wood is a substance furnished by Nature as an expedient for man's intermediate state, and which, when he attains his whole birthright of knowledge will only be used for ornamental purposes.

I remain, Sir, yours,

JUNIUS REDIVIVUS.

October 15, 1842.

## ON THERMOGRAPHY, OR THE ART OF COPYING ENGRAVINGS, OR ANY PRINTED CHARACTERS, FROM PAPER ON METAL PLATES—BY ROBERT HUNT, ESQ., SECRETARY TO THE ROYAL CORNWALL POLYTECHNIC SOCIETY.

[READ AT THE MEETING OF THE SOCIETY, NOVEMBER 8, 1842.]

The Journal of the Academy of Sciences of Paris, for the 18th of July, 1842, contains a communication made by M. Regnault from M. Moser of Konigsberg, "Sur la formation des images Daguerriennes;"* in which he announces the fact, that "*when two bodies are sufficiently near, they impress their images upon each other.*" The Journal of the 29th of August contains a second communication from M. Moser, in which the results of his researches are summed up in twenty-six paragraphs. From these I select the following, which alone are to be considered on the present occasion.

"9. All bodies radiate light even in complete darkness.

"10. This light does not appear to be allied to phosphorescence, for there is no difference perceived whether the bodies have been long in the dark, or whether they have been just exposed to daylight, or even to direct solar light.

"10. Two bodies constantly impress their images on each other, even in complete darkness.

"14. However, for the image to be appreciable it is necessary, because of the divergence of the rays, that the distance of the bodies should not be very considerable.

"15. To render the image visible, the vapour of water, mercury, iodine, &c., may be used.

"17. There exists *latent light* as well as latent heat."

The announcement at the last meeting of the British Association of these discoveries, naturally excited a more than ordinary degree of interest. A discovery of this kind, changing, as it does, the features, not only of the theories of light adopted by philosophers, but also the commonly received opinions of mankind, was more calculated to awaken attention than any thing which has been brought before the public since the publication of Daguerre's beautiful photographic process. Having instituted a series of experiments, the results of which appear to prove that these phenomena are not produced by *latent light*, I am desirous of recording them.

I would not be understood as denying the absorption of light by bodies, of this I think we have abundant proof, and it is a matter well deserving attention. If we pluck a nasturtium when the sun is shining brightly on the flower, and carry it into a dark room, we shall still be enabled to see it by the light which it emits.

The human hand will sometimes exhibit the same phenomenon, and many other instances might be adduced in proof of the absorption of light; and, I believe, indeed the principle that light is latent in bodies. I have only to show that the conclusions of M. Moser have been formed somewhat hastily, being led, no doubt, by the striking similarity which exists between the effects produced on the Daguerreotype plates under the influence of light, and by the juxtaposition of bodies in the dark, to consider them as the work of the same element.

1. Dr. Draper, in the *Philosophical Magazine* for September, 1840, mentions a fact which has been long known, "That if a piece of very *cold* clear glass, or what is better, a *cold* polished metallic reflector, has a little object, such as a piece of metal, laid on it, and the surface be breathed over once, the object being then carefully removed, as often as you breathe again on the surface, a spectral image of it may be seen, and this singular phenomenon may be exhibited for many days after the first trial is made." Several similar experiments are mentioned, all of them going to show that some mysterious molecular change has taken place on the metallic surface, which occasions it to condense vapours unequally.

2. On repeating this simple experiment, I find that it is necessary for the production of a good effect, to use dissimilar metals; for instance, a piece of gold or platina on a plate of copper or of silver will make a very decided image, whereas, copper or silver on their respective plates gives but a very faint one, and bodies which are bad conductors of heat placed on good conductors, make decidedly the strongest impressions when thus treated.

3. I placed upon a well-polished copper plate, a sovereign, a shilling, a large silver medal, and a penny. The plate was gently warmed by passing a spirit lamp along its under surface; when cold, the plate was exposed to the vapour of mercury; each piece had made its impression, but those made by the gold and the large medal were most distinct, not only was the disc marked, but the lettering on each was copied.

4. A bronze medal was supported upon slips of wood, placed on the copper, $\frac{1}{8}$th of an inch above the plate. After mercurialization, the space the medal covered was well marked, and for a considerable distance

* Comptes Rendus, tome xv., No. 3, folio 119.

around the mercury was unequally deposited, giving a shaded border to the image; the spaces touched by the slips of wood were thickly covered with the vapour.

5. The above coins and medals were all placed on the plate, and it was made too hot to be handled, and allowed to cool without their being removed; impressions were made on the plate in the following order of intensity,—gold, silver, bronze, copper. The mass of the metal was found to influence materially the result; a large piece of copper making a better image than a small piece of silver. When this plate was exposed to vapour, the results were as before (3, 4). On rubbing off the vapour, it was found that the gold and silver had made permanent impressions on the copper.

6. The above being repeated with a still greater heat, the image of the copper coin was, as well as the others, most faithfully given, but the gold and silver only made permanent impressions.

7. A *silvered* copper plate was now tried with a moderate warmth (3). Mercurial vapour brought out good images of the gold and copper; the silver marked, but not well defined.

8. Having repeated the above experiments many times with the same results, I was desirous of ascertaining if electricity had any similar effect; powerful discharges were passed through and over the plate and discs, and it was subjected to a long continued current without any effect. The silver had been cleaned off from the plate (7), it was now warmed with the coins and medals upon it, and submitted to discharges from a very large Leyden jar; on exposing it to mercurial vapour, the impressions were very prettily brought out, and strange to say, spectral images of those which had been received on the plate when it was silvered (7). Thus proving that the influence, whatever it may be, was exerted to some depth in the metal.

9. I placed upon a plate of copper, blue, ed, and orange coloured glasses, pieces of crown and flint glass, mica, and a square of tracing paper. These were allowed to remain in contact half an hour. The space occupied by the red glass was well marked, that covered by the orange, was less distinct, but the blue glass left no impression; the shapes of the flint and crown glass were well made out, and a remarkably strong impression where the crown glass rested on the tracing paper, but the mica had not made any impression.

10. The last experiment repeated. After the exposure to mercurial vapour, heat was again applied to dissipate it; the impression still remained.

11. The experiment repeated, but the vapour of iodine used instead of that of mercury. The impressions of the glasses appeared in the same order as before, but also a very beautiful image of the mica was developed, and the paper well marked out, showing some relation to exist between the substances used, and the vapours applied.

12. Placed the glasses used above (9, &c.), with a piece of well-smoked glass for half an hour, one-twelfth of an inch below a polished plate of copper. The vapour of mercury brought out the image of the smoked glass only.

13. All these glasses were placed on the copper, and slightly warmed; red and smoked glasses gave, after vaporization, equally distinct images; the orange the next; the others left but faint marks of their forms. Polishing with Tripoli and putty powder would not remove the images of the smoked and red glasses.

14. An etching, made upon a smoked etching ground on glass, the copper and glass being placed in contact. The image of the glass only could be brought out.

15. A design cut out in paper, was pressed close to a copper plate by a piece of glass, and then exposed to a gentle heat; the impression was brought out by the vapour of mercury in beautiful distinctness. On endeavouring to rub off the vapour, it was found, that all those parts which the paper covered, amalgamated with mercury, which was removed from the rest of the plates; hence there resulted a perfectly permanent white picture on a polished copper plate.

16. The coloured glasses before named (9, 12), were placed on a plate of copper, with a thick piece of charcoal, a copper coin, the mica and the paper, and exposed to fervent sunshine. Mercurial vapour brought up the images in the following order, smoked glass, crown glass, red glass, mica, beautifully delineated, orange glass, paper, charcoal, the coin, blue glass; thus distinctly proving, that the only rays which had any influence on the metal, were the calorific rays. This experiment was repeated on different metals, and with various materials, the plate being exposed to steam, mercury, and iodine; I invariably found that those bodies which absorbed or permitted the permeation of the most heat gave the best images. The blue and violet rays could not be detected to leave any evidence of action, and as spectra imprinted on photographic papers by light, which had permeated these glasses, gave evidence of the large quantity of the invisible rays which passed them freely, we may also consider those as entirely without the power of effecting any change on compact simple bodies.

17. In a paper which I published in the

Philosophical Magazine, for October, 1840, I mentioned some instances in which I had copied printed pages and engravings on iodized paper, by mere contact and exposure to the influence of the calorific rays, or to artificial heat. I then, speculating on the probability of our being enabled by some such process as the one I then named, to copy pictures and the like, proposed the name of *Thermography*, to distinguish it from Photography.

18. I now tried the effects of a print in close contact with a well polished copper plate. When exposed to mercury, I found that the outline was very faithfully copied on the metal.

19. A paper ornament was pressed between two plates of glass, and warmed; the impression was brought out with tolerable distinctness on the under and warmest glass, but scarcely traceable on the other.

20. Rose leaves were faithfully copied on a piece of tin plate, exposed to the full influence of sunshine, but a much better impression was obtained by a prolonged exposure in the dark.

21. With a view of ascertaining the distance at which bodies might be copied, I placed upon a plate of polished copper, a thick piece of plate glass, over this a square of metal, and several other things, each being larger than the body beneath. These were all covered by a deal box, which was more than half an inch distant from the plate. Things were left in this position for a night. On exposing to the vapour of mercury it was found that each article was copied, the bottom of the deal box more faithfully than any of the others, the grain of the wood being imaged on the plate.

22. Having found, by a series of experiments, that a blackened paper made a stronger image than a white one, I very anxiously tried to effect the copying of a printed page or a print. I was partially successful on several metals, but it was not until I used copper plates amalgamated on one surface, and the mercury brought to a very high polish, that I produced anything of good promise. By carefully preparing the amalgamated surface of the copper I was at length enabled to copy from paper, line-engravings, wood cuts, and lithographs, with surprising accuracy. The first specimens produced, exhibit a minuteness of detail and sharpness of outline, quite equal to the early Daguerreotypes and the Photographic copies, prepared with chloride of silver.*

The following is the process at present adopted by me, which I consider far from perfect, but which affords us very delicate images.

A well polished plate of copper is rubbed over with the nitrate of mercury, and then well washed to remove any nitrate of copper which may be formed; when quite dry a little mercury taken up on soft leather or linen is well rubbed over it, and the surface worked to a perfect mirror.

The sheet to be copied is placed smoothly over the mercurial surface, and a sheet or two of soft, clean paper being placed upon it, is pressed into equal contact with the metal, by a piece of glass, or flat board; in this state it is allowed to remain for an hour or two. The time may be considerably shortened by applying a very gentle heat for a few minutes to the under surface of the plate. The heat must on no account be so great as to volatalize the mercury. The next process is to place the plate of metal in a closed box, prepared for generating the vapour of mercury. The vapour is to be slowly evolved, and in a few seconds the picture will begin to appear; the vapour of mercury attacks those parts which correspond to the white parts of the printed page or engraving, and gives a very faithful. but a somewhat indistinct image. The plate is now removed from the mercurial box, and placed into one containing iodine, to the vapour of which it is exposed for a short time; it will soon be very evident that the iodine vapour attacks those parts which are free from mercurial vapour, blackening them. Hence there results a perfectly black picture, contrasted with the grey ground formed by the mercurial vapour. The picture being formed by the vapours of mercury and iodine, is of course in the same state as a Daguerreotype picture, and is readily destroyed by rubbing. From the depth to which I find the impression made into the metal, I confidently hope to be enabled to give to these singular and beautiful productions, a considerable degree of permanence, so that they may be used by engravers for working on.

It is a curious fact that the vapours of mercury and of iodine attack the plate differently, and I believe it will be found that vapours have some distinct relation to the chemical, or thermo-electrical state of the bodies upon which they are received. Moser has observed this, and attributes the phenomena to the colours of the rays, which he supposes to become latent in the vapour on its passing from the solid into the more subtile form. I do not however think this explanation will agree with the results of experiments. I feel convinced that we have to deal with

* The first faithful copy of the lines of a copperplate engraving was obtained by Mr. Cantabrana, who has since succeeded in procuring some tolerable specimens, on unamalgamated copper, which cannot be rubbed off.

some thermic influence, and that it will eventually be found that some purely calorific excitement produces a molecular change, or that a thermo-electric action is induced, which effects some change in the polarities of the ultimate atoms of the solid.

These are matters which can only be decided by a series of well conducted experiments, and, although the subject will not be laid aside by me, I hope the few curious and certainly important facts which I have brought before you, will elicit the attention of those whose leisure, and well known experimental talents, qualify them in the highest degree for the interesting research into the action of those secret agents, which exert so powerful an influence over the laws of the material creation. Although attention was called to the singular manner in which vapours disposed themselves on plates of glass and copper, two years since by Dr. Draper, Professor of chemistry at New York, and about the same time to the calorific powers of the solar spectrum, by Sir John Herschel,* and to the influence of heat artificially applied, by myself (17) yet it is certainly due to M. Moser of Konigsberg, to acknowledge him to be the first who has forcibly called the attention of the scientific world to an enquiry which promises to be as important in its results, as the discovery of the electric pile by Volta.

As to the practical utility of this discovery, when we reflect on the astonishing progress made in the art of Photography since Mr. Fox Talbot published his first process, what may we not expect from Thermography, the first rude specimens of which exhibit far greater perfection than the early efforts of the sister art?

As a subject of pure scientific interest, Thermography promises to develope some of those secret influences which operate in the mysterious arrangements of the atomic constituents of matter, to show us the road into the yet hidden recesses of nature's works, and enable us to pierce the mists which at present envelope some of the most striking phenomena, which the penetration and industry of a few "chosen minds" have brought before our obscured visions. It has placed us at the entrance of a great river, flowing into a mighty sea, which mirrors in its glowing waters some of the most brilliant stars which beam through the atmosphere of truth.

ROBERT HUNT.

Falmouth, November 7, 1842.

* Philosophical Transactions, Part 1st for 1840, page 50.

## MR. SAMUEL HALL'S PATENT CONDENSERS.

### *Report of Sir W. Edward Parry and Messrs. Ewart and Lloyd to the Lords of the Admiralty.*

In pursuance of Sir George Cockburn's minute of the 19th of February, 1842, on the statement accompanying Mr. Samuel Hall's note of the 7th February, we beg leave to submit the following report, founded upon all the information which could be obtained respecting the results of the application of Hall's condensers to vessels now in her Majesty's service; and upon consideration of the present condition of the condensers of the *Megæra*, and the effects which this system of condensation appears to have produced with regard to the consumption of fuel, and the condition of some parts of her engines and boilers.

Having understood that Hall's condensers had been tried in several steam-vessels belonging to the St. George Company, and subsequently removed from them, Commander Bevis was directed to make special inquiry as to the circumstances attending such removal. By Commander Bevis's report of the 10th of March (enclosed herewith), it appears that these condensers were applied to six vessels, and removed from them after a trial varying from two to six years, in consequence, as it is acknowledged, of their complicated construction, and the difficulty of keeping them in order. This is entirely at variance with the experience afforded by the *Megæra* during a trial of four years, during the last three years of which the condensers were never even opened for inspection, and they are now in good condition. The report of the engineer officers of Woolwich Yard, dated 11th of March (transmitted herewith), is conclusive on this point.

Although in ordinary cases the vacuum is better with Hall's condensers than with those of common construction, it is necessary to state that we have been informed that in tropical climates, where the temperature of the sea water used for condensing the steam is high, the process of condensation is less perfectly performed by Mr. Hall's condensers than by the common ones. An application has been made to the East India Company to furnish any facts which might throw light on this part of the subject, but they do not at present possess the required information. If, however, this difficulty should be found to exist in a tropical climate, we think it probable some means of obviating it might be devised.

To ascertain the saving of fuel, we have made the comparison between the consumption of the *Megæra* and the *Volcano*. The

boilers of the *Volcano* are of copper, and those of the *Megæra* are of iron, with Hall's condensers; in other respects the vessels are alike. From the accompanying account it will be seen that the average daily consumption of fuel on board these vessels has been obtained in two ways, perfectly distinct from each other:—

*First*, by ascertaining from the logs of the respective vessels the number of days in which the engines were at work, and comparing it with the total quantity of fuel expended. *Secondly*, by taking an average of the consumption of fuel per horse power per hour, as reported by the commanders in the monthly returns.—The average daily consumption in the

| | | Tons. |
|---|---|---|
| *Megæra* was, by the | first mode.. | 14 5·7 |
| ,, ,, | second mode | 13 41·56 |
| | Mean...... | $14\frac{1}{2}$ |
| *Volcano* was, by the | first mode.. | 17 13·60 |
| ,, ,, | second mode | 18 4·5 |
| | Mean...... | 18 |

—showing a saving per day of $3\frac{1}{2}$ tons, or nearly 20 per cent.; or if, as an approximation, the vessel be supposed to run 150 days in the year, and the cost of the coal be estimated at 20*s*. per ton, the saving in the cost of coal would amount to 525*l*. per annum.

The comparative consumption of fuel in these two vessels could not materially differ from what is here given, but we are not prepared to say that this great saving is entirely to be attributed to Mr. Hall's condensers. Some part might have arisen from the commanders constantly evincing a strong desire to economise the fuel, and from the care and judicious management of the engineer. A considerable saving, however, must, we think, always obtain, from there being no necessity for blowing out at short intervals a part of the boiling water, from their being no incrustation within the boiler to impede the transmission of heat, and from the necessity which this system of condensation induces, to prevent, as far as possible, any waste of steam, as its place must be supplied by fresh water produced by distillation from salt water.

No account can be rendered of the comparative cost of repairs in these two vessels, in consequence of the repairs being performed by contract, and of the boilers of the *Volcano* being made of copper; but considering that the whole of the internal parts of the boilers of the *Megæra* are now perfectly good, which, when salt water is used in iron boilers for an equal length of time is never the case, and that the condition of some parts of the engines is certainly better than if salt water had been used, we think we should not estimate too highly the annual saving in repairs at 150*l*., which with the estimated value of the saving in fuel, would amount to 675*l*.

The first cost of the patent condensers, according to the statement of Messrs. Seaward and Capel, is from 7*l*. to 8*l*. per horse power; according to Mr. Hall it is from 5*l*. to 10*l*. per cent. upon the cost of engines and boiler, or from $2\frac{1}{2}$ to 5*l*. per horse power. In conclusion, it may be remarked that Hall's condensers are calculated to enable a vessel to run without repairs for a longer time than common condensers; but to what extent we have not had sufficient experience to enable us to state with any degree of certainty.

W. E. PARRY.
P. EWART.
T. LLOYD.

## WIRE ROPE LIGHTNING CONDUCTORS.

Sir,—It is a pity that your correspondent Mr. J. R. Hill does not take the trouble to make himself acquainted with all facts bearing upon a subject, before he writes on it; had he done this, he would not, I am sure, have taxed me with claiming an invention as my own, without having troubled myself to carry it out. It is now many years since I not only "suggested" wire rope conductors for ships, but also "encountered much difficulty, disappointment, and expense," in endeavouring to bring this lightning conductor into use: this, I believe, is well known to most electricians of the present day, and were it necessary, I could refer Mr. Hill to persons and documents, private, as well as connected with the government, that will bear me out, and that my plan provided for a perfect continuity of conduction, a safety from lateral explosion, especially the conduction of the electric fluid over the side of the ship, and an efficient method of shortening the conductor without injury to its continuity, when the top-gallant and top masts are struck. In future I hope therefore, that Mr. Hill will make himself a *little* acquainted with the facts of a case before he arbitrates on the claims of parties to inventions.

There is now no longer any question amongst persons *versed* in electrical-science, as to the course taken by electricity through conductors; for it has long been settled that conduction is in ratio of the mass, not of the surface of a conductor. Neither of the two experiments quoted by Mr. Hill prove anything to the point, but if he will take two equal lengths of iron wire of precisely the same diameter, and flatten one of these into a thin riband, and then pass equal charges

through the riband and the round wire, he will find them conducted with equal facility; of course, as Mr. Hill is so well versed in electricity I need not point out methods of proving the amount of conduction through each wire.

I have the honour, &c.,

MARTYN ROBERTS.

### FIRE-BASKETS.

Sir,—The present fire-baskets are adverse to perfect combustion, to good draught, to steadiness, to warmth, and to facility of mending the fire. A fire-basket should be of thinnish *cast iron* (thinnish for lightness, but not in too great a degree, for fear of unsteadiness); the backing, and the sides, should have holes in them, like the inner back of most register grates, but much more numerous and smaller, (this ensures perfect combustion); the bottom to be grated in like manner and of the same thickness, (for steadiness,) as ordinary grates, and the front to have very slender bars like the present fire-baskets. The dimensions to be as follows: height 6 inches; width in front, 8 inches; at back, 5 inches; and the internal depth from front to back $4\frac{1}{2}$ inches.

Some of your readers may perhaps manufacture such for the present season.

A CONSTANT READER.

### THE "GREAT BRITAIN" STEAMER.

Sir,—Your publication has given an able description of the "Great Britain" steamship, which has materially assisted to excite great interest in the public mind; and imagining your pages are still open to any observations, whether in approval of the merit (if any) of the management pursued, or in denunciation of the indiscreet expenditure of the company's resources, I beg leave to request a place for a few remarks on these points.

I am one of the unfortunate shareholders, and am now become so sick of the continued demands, and want of money, that I feel almost reckless of the consequences.

In August last, we were told that the cost of the new ship would not exceed 76,116*l.*; but at the meeting held at Bristol, on Friday last, *just three short months after*, we are told that the *estimated* cost is not to exceed 100,000*l.*! Surely, this is *arithmetical progression* with a vengeance, being at the rate of nearly 96,000*l.* per annum. I respectfully and most *feelingly* put it to my brother shareholders, whether it is not better, instead of reducing the weekly wages, from 367*l.* to 300*l.* as proposed, to increase them, and get *the thing* done, if possible, before another three months pass over our heads, or we may be told that the *estimated cost* will then not exceed 123,834*l.* A suggestion was made that the services of Mr. Guppy, who officiates as engineer, should be dispensed with, and thereby save 500*l.* a year; but I say *no!* If we are to finish the ship, let us procure the additional assistance of a *real, practical, industrious engineer*, in whose ability we may place confidence for the short time we are to remain a company, and that the 300*l.* or 400*l.* paid weekly be properly spent, and that the system of making, altering, and re-making, which has been so long practised to our cost, and of advantage to none but our salaried servants, be put an end to. I wish not to be understood as hinting at any incapacity in Mr. Guppy as *engineer*, seeing that the title and diploma may be had even easier than by setting one's legs under the office table of a C. E. in chief, for a couple of years. If 20,000*l.* is to be borrowed, let it be done at once; let the 17,000*l.* calls be enforced, the ship finished and sold, if possible; wind up the concern, and dismiss the living, as well as dead incumbrances. Judging from past experience, I dread to anticipate, that the more we spend the more we shall be required to supply.

An attempt was made to comfort us by the prospect of realizing 2781*l.* by the sale of timber and stores, but what the *stores* are, does not appear. Presuming it to be second-hand timber, sold at a *good price*, it would require, I am informed, about 55,620 cube feet, equal in bulk to fully *one quarter of* the bulk of the vessel.

One cannot but think that the people of Bristol, with the exception of two, are perfectly innocent of sleeping with "one eye open;" to me it appears that they keep both shut.

I am, Sir,

A LUCKLESS SHAREHOLDER.

Bath, November 15, 1842.

### DOMESTIC PUMP.

Sir,—Some time ago, on perusing your useful and instructive Magazine, I noticed with pleasure an account of a small pumping-engine to be fixed on board steamers, in order to relieve the poor stokers from their arduous duties in pumping up the boilers when the engines that work the vessel are not in motion. I beg now to call your attention to a new mode of raising water, invented by a Mr. Egeldine, for an equally laudable purpose, namely, the ease and comfort of the domestic servant. This talented gentleman has lately erected one of the

machines at Mr. Harmer's seat, Ingress Park, Greenhithe, which is now in daily use, and the performances, I should say, are perfectly satisfactory, though the inventor still thinks he can improve it considerably. One of the servants, when I was there, was procuring more water with it than I ever saw raised with a pump in the same space of time, and certainly with not a quarter the labour of a common pump handle. Much praise is due to the inventor, for the simplicity of its construction, and also for the taste he has displayed in its appearance, which is both light and elegant.

It is to be hoped, that as soon as he has secured his patent, he will make this valuable invention known to the public, who cannot fail shortly to adopt these machines generally, more especially as the cost is very trifling.

Knowing how willing you are to make known any new invention, I hope you will favour me with a corner for this notice at your earliest convenience.

Yours, &c. &c.,

A CONSTANT READER.

WORKING FIRE-ENGINES.

Sir,—In the present volume of the *Mechanics' Magazine*, page 364, your intelligent correspondent, Mr. Baddeley says, "In working fire-engines, under certain circumstances, a very striking and somewhat inconvenient illustration is afforded of the *vis inertia* of fluids. This happens when the hose is led to the top of a high building, or has by other means a great altitude given to it. So long as the engine is worked, and the ascending column of water kept in motion, the jet is delivered from the branch pipe in the usual way; but, should the engine be stopped for a few minutes, to shift the hose, &c., the pressure of the quiescent column of water cannot be overcome. On beginning again to work the engine, the delivery valves become *set in an open position;* the engine handles fly freely up and down, as the water passes from one barrel to the other, which is the only effect that can be produced. The *vis inertia* of the high column of water contained in the elevated hose cannot be thus overcome, but must be got rid of in another way."

Now, Sir, I do not see what the *vis inertia* of fluids has to do with the effect your correspondent complains of; for, in my humble opinion, it arises from quite a different cause; and I should think there is scarcely a practical fireman but is aware of it, and has a remedy at hand. The cause generally originates from the more or less unsound state of the cock, feed or suction pipe, particularly when more than one length is on, which admits a portion of air through the seams, joints, &c., yet not sufficient to prevent the engine fetching, or charging itself at first. The consequence is, that on any stoppage of the engine for a short time, to shift the hose, &c., the air so admitted into the feed-pipe displaces the water therein, and on the order "Go on," the air must first be extracted and allowed to escape through the main valves, before the barrels will be charged with water, and work. But the main valves are firmly closed by the superior weight of the column of water, instead of being *set in an open position*, as Mr. Baddeley says; and, by the motion of the piston up and down, a portion of the air in the feed pipe gets into the barrels, and is there alternately expanded and condensed, without any discharge of water from the branch pipe; the spring or force of the air so condensed not being sufficient to open the main valves and escape. To remedy the evil complained of, without any *addition to the engine*, all that is necessary is, previously to discharging the water on the fire, to pump some water into the cistern of the engine, (which I have frequently done,) say till it is half full, and when the engine becomes affected by the *vis inertia* of the fluid, to turn the handle of the cock a few seconds to feed from the cistern, when the barrels will become charged with water. Immediately turn the handle back, and the engine will work from the feed pipe as usual. I have tried this several times, and always succeeded. If the feed pipes, cocks, &c., always continued sound, or when working from the cistern, the engine would always work after any stoppage, whether fitted with angular valves or others.

Trusting to your kindness for an early insertion of this in your valuable Magazine,

I am, Sir, your obedient servant,

AN OLD SUBSCRIBER.

Maidstone, Nov. 10, 1842.

OPTICAL DELUSION IN RAIN DROPS.

Sir,—While under a shower of rain, I have stooped my head to allow the rain to run from my hat, and thus looking down perpendicularly on the drops as they fell, they appeared to be as black as ink; so much so, that at first I thought they were discoloured from the black dye of the hat. The same rain drops, looked at horizontally, while yet hanging to the leaf of the hat, sparkled like diamonds.

J. N.

MR. READMAN'S BAROMETER.

Sir,—Having read the communication of Mr. Coathupe, in your Journal for October 22, relative to my improvements in barometers, in which he lays claim to priority of invention, on the ground of a letter which he addressed to the editor of the *Meteorological Journal*, in February last, I beg leave to inform that gentleman, that, in addition to your testimony, Mr. Editor, in my favour, I am able to bring forward evidence to prove that my invention had been matured by me full half-a-year before the publication of his letter.

From the concluding paragraph of Mr. C.'s communication, the reader would be apt to infer that the inventions of that gentleman and myself were identical, whereas the principle of suspending or placing the cistern of the barometer on a spring or balance is the only point in which they do agree; the purposes to which that principle is applied being totally different. The use to which I have applied this principle, and which constitutes the chief value of my invention, consists in the substitution of the *weight of the mercury in the cistern*, instead of the *length of the barometric column*, as the index of the atmospheric pressure, by which means several defects in the barometer are obviated. Now, the sole use to which Mr. Coathupe, in his letter, proposes to apply the same principle consists in the *self-adjustment of the surface of the mercury in the cistern to the zero point of the scale.* The identity of the two inventions, therefore, the reader will perceive, extends no farther than to the principle on which they are founded.

I remain, Sir,

Your obedient servant,

JAMES READMAN.

November 9, 1842.

ABSTRACTS OF SPECIFICATIONS OF ENGLISH PATENTS RECENTLY ENROLLED.

JAMES CLEMENTS, OF LIVERPOOL, *for certain improvements in composition for ornamenting glass and picture frames, and articles for interior and other decorations; also, for the manufacture of toys and other carriages.* Patent dated, March 4, 1842.

The pulp of potatoes, boiled, roasted, or steamed, is to be mixed with some suitable binding material, as fine saw-dust, ground brick, &c., and this, it is said, will form a composition, which may be cast in moulds of any ornamental form desired.

EDWARD SLAUGHTER, OF BRISTOL, ENGINEER, *for improvements in the construction of iron wheels for railway, and other fancy articles.* March 4, 1842.

The spokes and tire are to be of malleable iron, and dovetailed the one into the other; after which, the nave is to be *cast* on the ends of the spokes. The patentee also gives his spokes a peculiarly curved form; but to this he makes no claim.

THOMAS HEDLEY, OF NEWCASTLE-ON-TYNE, GENTLEMAN, AND CUTHBERT RODHAM, OF GATESHEAD, MILLWRIGHT, *for an apparatus for purifying the smoke, gases, and nauseous vapours, arising from certain fires, stoves, and furnaces.* March 7, 1842.

A revival of the plan, patented (we rather think, more than once,) many years ago. The smoke or vapours are caused to traverse two shafts, one ascending and the other descending, from the top of the latter of which a shower of water is constantly falling, which washes the smoke or vapours free from all impurities. The only difference between this and the former plan is, that six flues are employed instead of two; that is to say, three ascending flues, and three descending, or shower flues.

HENRY BARRON RODWAY, OF BIRMINGHAM, WINE MERCHANT, *for improvements in the manufacture of horse-shoes.* March 7, 1842.

Every person must have noticed that, in a horse-shoe, as commonly made, there is a small groove towards the outer edge, to receive the heads of the nails, by which the shoe is secured to the foot of the horse; and, if he has a nice eye for proportions, he may also be able to call to mind that this groove is commonly about a quarter of an inch wide—never so much as three-eighths. On these rather minute premises there is here built an astonishingly sweeping patent. "Nobody," quoth Mr. Rodway, "has made horse-shoes with a groove exceeding three-eighths of an inch. I will, therefore, (happy thought!) monopolize to myself that width, and all beyond it." His actual words, in the specification before us—duly signed, sealed, and enrolled—are these: "I do not claim the making of horse-shoes with grooves, generally, *but only such grooves as are at least three-eighths of an inch wide.*" Make them of $\frac{5}{16}$ths, or $\frac{11}{32}$ndths, or $\frac{23}{64}$ths of an inch, or of any size, however small, less than $\frac{3}{8}$ths of an inch, and you are safe; but only make them of the patent $\frac{3}{8}$ths width, or one hair's-breadth beyond it, and you shall have a costly, perhaps ruinous law-suit for your pains.

By such patents as this, the encouragement given by the law of the country to new inventions is not used for its legitimate purposes, but most grossly abused.

CHARLES WILLIAM FIRCHILD, OF WESLEY PARK, WORCESTERSHIRE, FARMER, *for an improved propelling apparatus for marine and other purposes.* March 14, 1842.

A pair of steam-engines are to be employed, as usual in steam-vessels, but the cylinders are to be fixed horizontally in the stern of the vessel, and the piston-rods are to pass through the cylinder both at top and bottom. The inner ends of the pistons are to be connected with a crank-shaft, and the outer ends with a secondary pair of pistons, of a square form, which are to work in two hollow square chambers open to the water behind. The notion (evidently a very foolish one) of the patentee is, that the alternate action of his circular pistons on his square pistons, and of his square pistons against the columns of water admitted from behind, will propel a vessel forward much more effectually than paddles, screws, or any thing else, we presume, yet invented for the purpose.

M. S. Beach, of Norfolk-street, London, Printer, *for improvements in machinery used for printing with type, and in the construction of type for printing.* March 23, 1842.

The general object of these improvements is, to extend what may be called the *cylindrical system* more generally to the art of letter-press printing than has yet been done. With this view, the patentee proposes that the types, instead of being set up, as at present, in flat composing-sticks, should be set up in sticks of a circular, or partly circular form, and the types themselves be tapered to suit that form; that, besides using rollers for feeding the paper and inking the types, as in the present machine printing, the types also should be adjusted on rollers; and, finally, that the paper, instead of being supplied, as it now is, in separate sheets, should be supplied in continuous lengths, of as many yards as a shaft will conveniently carry, and cut off, at any distances required, by knives suitably placed and acted upon for the purpose. Subordinate to these principal improvements there is an apparatus for damping and pressing the paper; and also a new sort of hand-press, for taking proofs. The specification of the patentee is illustrated by no less than thirty-two drawings; and it needs them, for, taken by itself, ti is very confused, (what printers would call of the *pie* order,) and any thing but intelligible. Of Mr. Beach's improvements themselves it is impossible to speak in terms of too high praise; they are all of them exceedingly ingenious, all more or less feasible, and some, (the supply of the paper, for example, in continuous lengths,) of obvious and unquestionable utility.

Julius Seybel, of Golden-square, Manufacturing Chemist, *for improvements in the manufacture of sulphate of soda and chlorine.* March 31, 1842.

These improvements consist, first, in manufacturing the sulphate of soda by adding to 20 cwt. of common salt, contained in a close leaden vessel, 30 cwt. of sulphuric acid, "of 1·71," and heating the said vessel, externally, to from 300° to 330° Fahr.; and, secondly, in manufacturing chlorine, by employing "the vapours of muriatic acid to act on manganese immersed in water, such vapour being conducted below, and permitted to escape upward, through the water and manganese."

Joseph Clisold Daniell, of Tiverton Mills, *for improvements in making and preparing food for cattle.* March 31, 1842.

Birch brooms, or furze fences, are to be made good food for cattle, by grinding them to a fine powder, and mixing them with some corn and a *good deal of chaff*. Straw and hay is also to be made as fresh and succulent as new-mown grass or clover, by throwing a bundle of the former and two bundles of the latter into a close vat or tank, and steaming them together for twenty-four hours.

Mr. Daniell is a great dealer in agricultural nostrums.

Raoul Armand Joseph Jean Comte de la Charite, Richard Tappin Claridge, of Weymouth-street, Gentleman, and Robert Hodgson, of Salisbury-street, Strand, Gentleman, *for improvements in preparing surfaces of fabrics to be used in covering roofs, floors, and other surfaces.* April 26, 1842.

These improvements consist in coating canvas with a composition called by the patentees, "Oropholithe." It consists of the following ingredients, well mixed together:

Linseed-oil, 8 parts;
Litharge, or white-lead, 4 parts;
Dry powdered whiting, 9 parts;
Dry sand, 36 parts.

If a light-coloured oropholithe be required, then unboiled linseed-oil must be used. If a particularly tenacious cement be not required, or if of a darker cast, boiled linseed-oil is used. Any colour can be given to the orophbolithe, by using colouring matter of the required shade. The whiting and sand must be quite dry, and passed through a fine sieve previous to mixing.

The thickness of the composition depends on the service for which it is required. If for places not exposed to wet, the composition is only laid on one side of the fabric, to the extent of $\frac{1}{16}$th of an inch; if for places exposed to the wet, it is then laid on both sides.

The claim is to the composition for covering roofs, floors, and other surfaces, consisting of the materials before mentioned, in the proportions specified.

JOSEPH WARREN, OF HEYBRIDGE, *for certain improvements in ploughs.* May 9, 1842.

The present improvements are six in number.

The first consists in regulating the depth to which the share of the plough is inserted in the ground by means of a wedge (acted on by a screw) which is passed under the ploughshare from behind, and in proportion as it raises it at the back, depresses it in front; also in regulating the height and elevation of the beam, to suit the general line of draught by a peculiar combination of shifting bolts and screws.

The second improvement is a modification of the second branch of the first.

The third consists in a mode of raising at pleasure, the frame of the plough at the back part so as to depress the ploughshare in front. An upright rod connects the sole at the after part with the top and bottom parts of the frame, which rod is screwed at that part where it passes through the bottom part of the frame, so that by turning it round (by a spanner, or any other convenient means,) the back part of the frame is detached from and raised above the sole, and the ploughshare in front is proportionally depressed.

The fourth improvement consists in giving the ploughshare, when intended to be used in the tilling of stony land, a more elongated and pointed form than usual.

The fifth improvement consists in a double breasted plough, of which the chief peculiarity is, that the mould boards are so curved that they present an outline continually receding or diverging outwards from the base to the upper extremity.

The sixth and last improvement consists in a wheel plough for making drains, which seems likely to answer the purpose well, but the construction of which, could not be made clear to the reader without the aid of the explanatory drawings.

WILLIAM RICHARD, THE ELDER, OF BARLEY-MILLS, LEEDS, MANUFACTURER, *for an improved method of preventing and consuming smoke, and economizing fuel in steam-engines.* July 7, 1842.

A pneumatic apparatus, precisely similar in principle and action to the well-known (station) gasometer, is here applied to the purpose of supplying atmospheric air to a furnace. Every time the door of the furnace is opened to throw on fresh coals, it acts on certain levers which simultaneously open the passage to a number of air-holes, formed at the back of the bridge, (*à la Williams,*) and set the gasometer-like apparatus or bellows to work; and this air-feeding apparatus is provided with certain other appliances, by means of which (after the furnace-door is closed) it is gradually brought to a state of equilibrium or rest, and the air-passages to the furnace closed.

## RECENT AMERICAN PATENTS.

[Selected and abridged from the *Franklin Journal* for September, 1842.]

IMPROVEMENT IN FIRE-ENGINES. *Joseph B. Babcock.*—The cylinders and pistons, or plungers, are placed horizontally, and these cylinders, with the part of the apparatus to which they are attached, are secured down to the bottom of the cistern. The pistons, or plungers are hollow, and are provided with valves for the admission of the water into the cylinders; they are attached to the ends of a square frame, inside, the side pieces of which are provided with racks, into which the teeth of two segment cog wheels work, said segments being attached to the brake.

IMPROVEMENT IN BEE-HIVES. *John M. Weeks.*—What is claimed as constituting this invention, and not previously known in bee-hives, is a mode of regulating the ventilation of the hive by means of tubes lined with wire gauze, and having apertures to which adjustable caps, perforated with similar apertures, are adapted. Also, combining a central box, and one or more collateral boxes, containing smaller hives, with a mode of ascertaining and regulating the temperature of the hives, by means of a thermometrical and ventilating apparatus.

CANAL LOCK. *Robert English.*—The patentee calls this "the air and water-acting sympathetic canal lock-gate."

At the upper end of the lock, which is the subject of this patent, there is to be an air-tight chamber, provided with what the patentee calls "sympathetic gates," which are hinged to the lock in such a manner as to shut one upon the other, the lowermost being provided with an air-tight float. Below these two gates there are two valves, one of which communicates with the water in the upper chamber of the lock, and the other with a culvert leading to a lower level. When the first-named valve is opened, the chamber below the gates is filled with water, which acting on the float, forces up the gates, and thus closes the lock; and when this valve is closed, and that leading to the calvert opened, the water running out of the chamber to a lower level, leaves a partial vaccuum below the gates, which are consequently forced down by the pressure of the atmosphere, aided by their own gravity; a communication is thus opened between the upper and lower levels. Where the water discharges from the upper to the lower level,

there is a breakwater attached by hinges to the lock to prevent the water from rushing too suddenly on to the boat in the lower lock.

MACHINE FOR CUTTING DOVETAILS AND TENONS. *Thomas J. Wells.*—The construction of this machine exhibits much mechanical skill. The cutters are attached to the periphery of a wheel on the end of a mandrel, and the wood to be tenoned is put on to a second mandrel, parallel to the first, the two being made to turn in the same direction, and with equal velocities. If the tenon is to be of four sides, four cutters are so arranged as to divide the periphery of the cutter wheel into four equal parts; and if the tenon is to be cut on two sides only, then two cutters are employed, and placed opposite to each other. As the cutters revolve they gradually approach the axis of the second mandrel, on which the wood is placed, until they reach a line passing through the axis of the two mandrels, and then they gradually recede from it.

The claim is to the before-described "mode of cutting tenons, or dovetails, or other forms, by a similar, simultaneous, rotary motion of the circular plane, and substance on which the tenon, dovetail, or other form, is to be made: the cutting being performed on an increment tangential line to the circumference of the revolving circular plane, whilst the cut made forms the chord line of a segment, on the piece of the circular rail cut away by the revolving cutter."

AN IMPROVED BRIDGE. *Earl Trumbull.*—This bridge, as described, is to be constructed of iron. It consists of arched truss frames, made in sections, the end of each section having a half post, and this, when united and tied to the half post of the next section, forms an entire post. These sections are farther sustained and connected together by suspension rods, which run from the upper part of one end section to the other, passing under the bottom of the middle section; and by tie rods that run from end to end along the lower line of the truss. The truss frames are connected together by transverse cast iron beams, or sills, on which the floor is laid, formed of a bottom and top plate connected together by diagonal braces, all cast together. In addition to these, the trusses are farther connected by diagonal tie rods, running from section to section, under the floor.

IMPROVEMENTS IN THE ARGAND BURNER, FOR BURNING CAMPHINE AND OTHER CHEMICAL OILS. *Stephen J. Gold.*—The claim is to the "mode of compressing the wick by means of two thin, moveable, metallic, cylindrical tubes, combined with the wick case, the two cylinders or wick tubes with the wick compressed between them being inserted into the annular space between the two cylinders of the wick case, with a portion of said wick tubes extending above the wick case, to allow of their being kept cool by the draught; and also for combining with the outer cylinder of the burner and the rod supporting the button, a moveable cylinder, or screw, disconnected from the rod, but having a button plate which, when the cylinder is turned up, presses against the rod and elevates it: and allows it, when turned down, to return either by its own weight, or by the action of a spring."

PORTABLE SAW MILL, FOR SAWING TIMBER WITH THE CIRCULAR SAW. *George Page.*—In this mill, the shaft of the circular saw has its bearings longer than the width of the boxes in which they run, so as to allow it to have free end play, and the saw is embraced on each side, just back of the teeth, between two friction rollers, which serve to guide it. Each of the guide rollers is attached to a separate plate, the two plates being placed one above the other, and provided with a slot for securing and setting the rollers. The carriage is made in sections for the convenience of transportation, the different sections being united by means of a rack rail at the bottom.

INDELIBLE INK. *Thomas J. Spear.*—The following is the whole of the specification, viz:—"Take three drachms of the least bruised India ink, and four ounces of boiling solution of caustic soda, and mix these together, and shake the mixture well for about ten minutes, when the indelible ink is produced."

MACHINE FOR CUTTING SHEET TIN, OR OTHER SHEET METAL, AND GLASS. *Andrew Tracy.*—This machine differs very little from other machines for the same purpose, which have been patented. The plate of metal to be operated on is held between two plates, each of which is attached to a rotating spindle, the uppermost being provided with a spring, which bears it up when not acted upon by an eccentric lever, by which it is forced down to hold the sheet of metal. The spindle of the upper plate is provided with a lever, with which to turn it when desired; it is furnished with a pall, which catches into the teeth of a ratchet wheel attached to the spindle. In operating with this machine, either the holding plates, with the sheet metal, may be made to turn, or the shears may be carried around the holding-plate, at pleasure.

IMPROVEMENT IN THE COOKING STOVE, CALLED THE "FRANKLIN ECONOMY COOKING STOVE." *Mathew Stewart.*—This stove contains a reflecting oven, the form of which is that of two truncated pyramids, united

at their bases, the inclined surfaces being intended to concentrate the heat in the centre. Each end of the oven is attached to a semi-cylindrical furnace, the chords of which are towards the centre of the oven. Over the furnaces there are openings for smoke pipes, and for cooking utensils.

Flour mill. *Andrew D. Worman.*—The middlings, which are to be mixed with the fresh ground chop from the burs, are put into a hopper prepared for that purpose, which hopper is so placed that the middlings contained in it shall be conducted from it into the spout or trough, in which the elevators are carrying up the fresh ground wheat to the hopper boy; and to the hopper containing the middlings is appended a shoe and a sliding shutter, in the ordinary way, for the purpose of regulating the feed from them. In this way the middlings will be perfectly and equally distributed and mixed among the fresh ground chop, and will be, in this state, carried through the respective processes to which the flour is subjected, until it is ready to be packed.

Harpoon for taking whales. *William Carsleys.*—The flukes or barbs of the harpoon are to be so twisted, as that, after being thrown, it shall, on entering the body of the animal, cut its way in an oblique or spiral direction.

Improved mode of propelling ships boats, and other vessels. *Elisha R Aldrich.*—In this improved mode of propelling boats, &c., the wheels are constructed with permanent radial paddles, the ends of which abut against the rims of the wheels, so that the principal part of the water against which the paddles act has to pass in between them, through the space between the inner periphery of the rims and the centre, or hub, and is forced out by centrifugal power against the water-back of the wheel, thus impelling the boat forward. The wheels constructed in this manner are placed either in hollow trunks or cases, within the vessel, or in similar cases built outside, and open at the bottom, the wheels projecting below the bottom of the trunks or cases; or they may, it is said, be placed horizontally, and act on the water at the sides of the vessel.

## SINGLE LINE RAILWAYS.

Sir,—Your polite invitation to me to make any further observations which might seem to me to be requisite in recommendation of my single railway, induces me to trouble you with the following remarks.

The advantages of a single rail over a double one must mainly consist in the saving of expense, which will always be more than half, inasmuch as all the links of connexion in the double rail are avoided, as well as the expense of two-thirds of the land over which it passes. The only question appears to be, how far these are objects worth attaining?

It has been said, that if commerce is benefited by the greater outlay, no matter for the ultimate loss to individual share-holders; but this, to me, is problematical, and hence I conclude that, in a single railway, the time lost in crossing at the central point is of no consideration, where the object is such immense saving. And now, Sir, as I think I can make out that in the single railway, of which I have made a correct model, I can considerably lessen the expense of the rail, render it more durable, and put it in its place by the aid of any common labourer, I will endeavour, unassisted by either plan or model, to give your readers some idea of the improvement.

My new rail consists of only two pieces, viz: the transvervse cast iron sleeper, and the railway beam, of which the following is a description. The base of each transverse piece is composed of two square slabs, measuring 4 feet each way, and 1 inch thick, connected together by a third slab of 2 feet in length, 1½ foot in breadth, and 1 inch in thickness. On each of the first slabs, in their exact central line, are erected two triangular brackets, whose base is 1 foot long, and perpendicular side, eleven inches; these brackets are cast with the slab, so that the two slabs, the piece that unites them, and the four brackets, are cast in one mass. These two brackets are so separated as exactly to receive and confine the rail, which when laid down occupies only half their breadth, the other half of which is left for the reception of each succeeding rail. The longitudinal sleepers are of wood 1 foot square, and 10 feet long, and each of the ends as far as it projects upon the square slab, is morticed away 1 inch of the lower surface. The iron rail reposed upon them, in its section resembles the letter T inverted (⊥), with its upper edge rounded off; and this iron rail is secured on the longitudinal sleepers by imbedded screws. Your readers will see by this arrangement, that the transverse pieces and sleepers, will all repose on the same level, and that the morticed parts and brackets will lock them together, and thus secure the regularity of the line.

The peculiar form of the iron rail will, I apprehend, weigh less by the foot than the most elevated of Mr. Brunel's rails on our Great Western, and offers to the wheels of the carriages a rounded saddleback, which is incapable of retaining loose bodies that may fall upon it, and is intended to carry wheels whose circumferences are grooved into the

form of the Saxon arch, wide enough to allow of some lateral action or oscillation, so that the whole pressure will be on the centre of the arch, whose base is never intended to touch the platform of the rail. By this means side friction would be avoided, for the tendency would always be to resume the centre of the wheel, and such a form would render it nearly impossible for the carriages to get off the rail. According to this plan we should also save the expense of transverse pieces of timber kyanized and pitched, together with the cutting, fitting, screwing, and bolting, and the frequent necessity of from time to time screwing up the bolts. I should recommend a space of from 5 to 7 feet between the rails. Its further advantages are, its simplicity, its intrinsic value, its portability, and its great safety.

By the assistance of a friend who is a good calculator, and concerned in an iron foundry, I find the price of the castings, at the present price of iron, would amount to the following sums.

The transverse piece in one casting will weigh 15 cwt. 2 qrs. 2 lbs., at 4*l.* per ton, 3*l.*; one at every 10 feet is 528 in a mile, which, at 3*l.* each, is about 1,600*l.* per mile. Rails at 50 lbs. weight per yard, and at 6*l.* per ton of rolled iron, comes, per mile, to 470*l.*; and thus the expense of the iron-work, per mile, is 2,070*l.*

I must not forget to add, that the wheels of the working steam-engine should be so constructed, as to have a bite base line of the rail, in contradistinction to the carriage-trains, whose weight would only press on the rounded part of the rail, at the centre, and whose flanges are never to touch the base.

I remain, Sir,

Your obliged humble servant,

G. Cumberland, Sen.

November 9, 1842.

## NOTES AND NOTICES.

*Steam-baked Bread.*—It has been known for some time at Vienna, that if the hearth of an oven be cleansed with a moistened wisp of straw, bread baked therein immediately afterwards presents a much better appearance, the crust having a beautiful yellow tint. It was thence inferred that this peculiarity must be attributed to the vapour, which being condensed on the roof of the oven fell back on the bread. At Paris, in order to secure with certainty so desirable an appearance, the following arrangement is practised:—The hearth of the oven is laid so as to form an inclined plane, with a rise of about eleven inches in three feet, and the arched roof is built lower at the end nearest the door, as compared with the furthest extremity. When the oven is charged, the entrance is closed with a wet bundle of straw. By this arrangement the steam is driven down on the bread, and a golden-yellow crust is given to the bread as if it had been previously covered with the yolk of an egg.—*Annals of Chemistry.*

*The Perlevesian Spectacles.*—Such is the name given to a new description of spectacles, manufactured by Ward, of the Quadrant, and remarkable for their extreme elegance and lightness (whence the name.) A pair of good sized glasses weighs only about a quarter of an ounce. The pebbles have grooves made in them all round their peripherics, for the reception of the frames, and it is by this means the ingenious maker has been enabled to reduce the weight so considerably.

*The late Shipwrecks.*—Many of the lamentable shipwrecks, which have of late been so frequent on our shores, might to a certainty have been averted, if the vessels had been provided with the marine thermometer, for which the admiralty have lately awarded the inventor, Mr. Clement, a grant of 200*l.* The *Reliance*, for example, is stated to have gone on shore in the night, but "when the wind was fair," and it is inferred that "they could never have seen the land;' that is to say, that they had lost their reckoning and did not know where they were. Now if there had been a marine thermometer on board, this admirable instrument would have indicated amidst the thickest darkness their approach to the rocks, in ample time to have enabled them to steer clear of them; and thus, at an expense of some 40*l.* or 50*l.* the lives of 113 persons, and property estimated to be worth 250,000*l.* might have been saved. So also with the brig *Hamilton*, wrecked on the Gunfleet sand: the weather was "exceedingly foggy; about four o'clock the word was 'breakers ahead,' and almost instantly she struck on the sands." With the marine thermometer no such disaster could have occurred; the navigator can steer his way with it as safely, (so far as rocks and sands are concerned,) as in the clearest sunshine. We hope that ere long not a vessel will be allowed to go to sea without one of these unerring guides on board.

*To separate Silver or Gold from Lead.*—Take a few grains of bone ash, make it into a paste with a little saliva, spread it about one line thick on a piece of charcoal, and make a shallow impression in it, to receive the globule of metal. Expose it to the heat of the blowpipe, so as to burn it white and hard, and then melt the globule of the alloy on it, and keep it in a constant red heat, till the lead is all oxidised. The advantages of the bone ash over the mica sometimes employed are manifold. 1. It is easier to be obtained, and everywhere the operator can prepare a little if he should not be supplied with it. 2. The metal will remain in the concavity of the bone ash paste, and not be liable to run down and be lost, as on the mica. 3. It is never necessary to change the material; the bone ash absorbs the litharge which collects on the mica, and impedes the process, so that the remaining metallic globule has to be transferred to a fresh slip of mica. 4. The colour of the paste, after the operation is finished, gives an indication as to the nature of some impurities of the metal; lead alone makes it appear yellow; a small proportion of copper changes this yellow colour to greenish.—*Dr. G. Engelmann.*



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## IMPROVED PLAN FOR WORKING THE SLIDE-VALVES OF HIGH-PRESSURE STEAM-ENGINES.

Fig. 1.

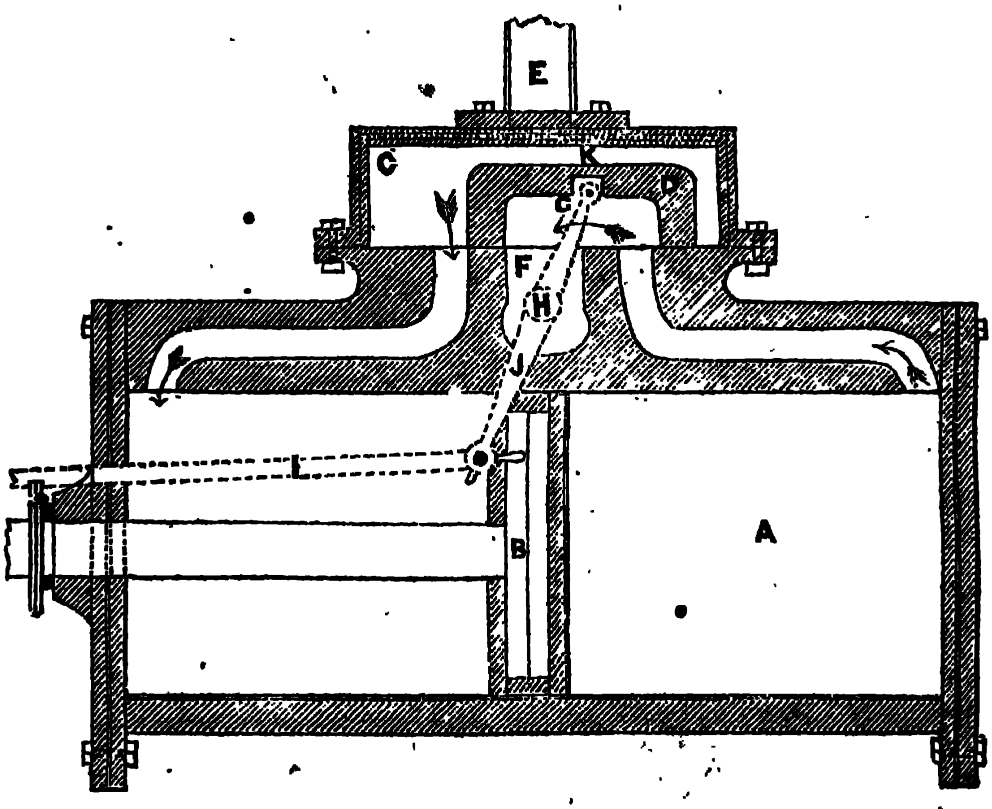



Fig. 2.

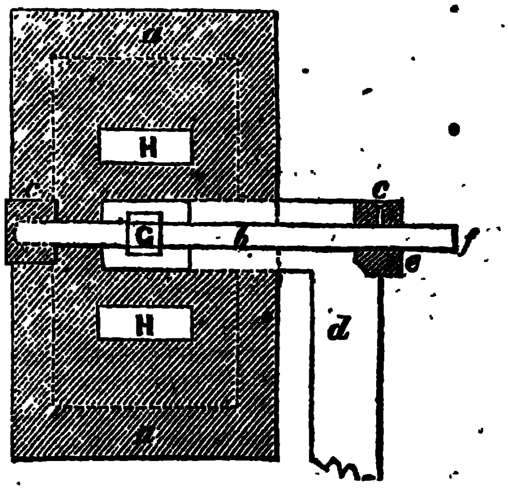
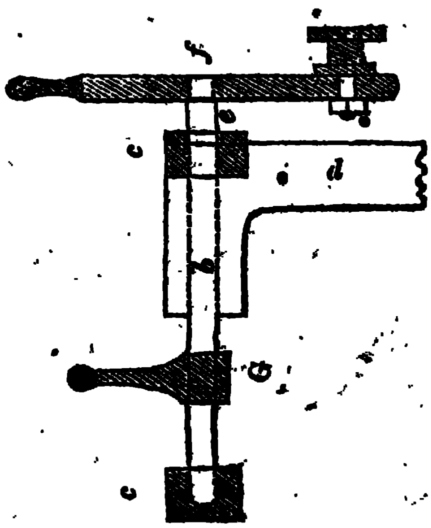



Fig. 3.



## IMPROVED PLAN FOR WORKING THE SLIDE-VALVES OF HIGH-PRESSURE STEAM-ENGINES.

Sir,—As you are always willing to receive any thing new, I take the liberty of sending you an account of my invention for working the slide-valves of high-pressure engines, without a stuffing-box and valve-rod, thereby dispensing with the usual set of levers and guides, and the continual packing and great friction attending stuffing-boxes of every description.

### *Description of the Engravings.*

Fig. 1. A, the cylinder; B, the piston; C, valve-box; D, valve; E, steam-pipe from boiler; F, waste steam passage, made sufficiently large to allow the steam to escape freely, and the spanner, G, fixed to the rocking-shaft, H, to move backwards and forwards; I, eccentric rod, taking hold of the lever J, fixed to the end of the rocking-shaft; K, square hole in the centre of the valve-cup, to admit the end of the spanner, G, to work the valve.

Figs. 2 and 3 show more clearly the rocking-shaft and its supports. *a a*, valve-plate; *b*, rocking-shaft; *c c*, its supports; *d*, waste steam-pipe; H H, steam-passages to the cylinder; G, lever fixed to the rocking-shaft, and working upwards through the centre of the eduction aperture, as in fig. 1; F, end of rocking-shaft, to fix hand-gear and eccentric lever for working the valve, as in fig. 3.

It will be seen that one end of the rocking-shaft passes through the waste steam-pipe at *e*; but as the steam there is not very strong or much valued, a common well-finished brass step will be found sufficient. By inserting the above in your valuable Magazine, you will greatly oblige,

Yours, &c.,

ROBERT H—LE.

P.S.—The above plan promises to be valuable for locomotive engines, as it admits of the eccentric rod being connected direct from the crank-shaft to the valve-lever.

## ON THE LATE PARIS AND VERSAILLES RAILWAY ACCIDENT.

BY BENJAMIN CHEVERTON, ESQ.

Sir,—Notwithstanding the official reports of public functionaries, and the scientific investigations—in popular estimation, at least, so accounted—of the learned members of the French Academy, it was reserved, it appears, for the *Mechanics' Magazine* to give the only satisfactory and intelligible statement, in regard to the probable origin and course of the accident on the Paris and Versailles Railway; and the information, most appropriately, has been furnished by a "*Practical* Engineer." And yet, if your correspondent's account of the accident be correct, (and really there is a satisfying *prima facie* truthfulness impressed on every particular of his statement,) it is surpassing strange, that men making any pretensions to the faculty of seeing, or assuming credit for the slightest talent for observation, should have overlooked the fact indicated by the indentings of the sleepers, that the engine had run off the rails a considerable distance previously to its complete overthrow. It is just possible, indeed, that they *did* notice the fact, but failed to draw any important inference from it; thus additionally illustrating the difference between practical and mere scientific acumen, in the investigation of such matters. The failure of the fore-axle having most conspicuously attracted their attention, they indolently took it for granted, that this was the first event in the course of the accident; and that the indentations must have arisen from a subsequent ploughing up of the road, by the deranged appurtenances of the broken-down engine.

It appears, however, that there was among the French *engineers* one acute observer of minute facts and apparently trivial circumstances—a man who, in the true spirit of practical talent, was disposed also to arrange and combine the information thus obtained, so as to make the inference irresistible, that the engine left the rails with the fore-axle, at least, entire—that subsequent to this, if not before, the engine was in a state of violent oscillation, both lateral and vertical —and that it went bounding on in this

way, over the sleepers, a considerable distance, until the tremendous shocks broke the fore-axle and brought all to the ground. This statement clears up most of the mystery about the accident: it satisfactorily accounts for the failure of the fore-axle, although the iron, by acknowledgment, was of the best quality; and it particularly explains how it came to be broke at *both ends*. This event is now seen to be the last, instead of the first of the series, as assumed in the official investigations, and as taken for granted on such authority, in all the subsequent discussions.

But how was it that no notice was taken, by the authorized reporters upon the accident, of the observations and inferences made by this engineer? Did he not come within the purview and cognizance of official and scientific dignity; or were those personages really incompetent, however mathematically clever, to appreciate inductive truth, or the manner of its evolution, through a *material* investigation of *physical* incidents, even when presented to them by others? It is surely better to impeach their sagacity than their integrity, in a matter of so much importance, and thus save them from the imputation of a design to suppress information on a subject on which the lives of thousands may depend on its being thoroughly and faithfully inquired into, while time and circumstances permitted M. Combes is a good mathematician, and can give *mathematical*, if not practical formulæ for the velocity of a current of air in the ventilation of mines; he is, moreover, the superintending government engineer of steam-engines in the department of the Seine; but in spite of all this, and in spite of the very best *Ecole Polytechnique* attainments, into which a man can be drilled, he does not appear to have been aware, that a six-wheel locomotive will as surely come to the ground as a four-wheel engine, in case a similar accident happens to its fore-axle as that which he supposes occasioned the late disaster; for he says in his report, what a little practical good sense, if not common sense, would have informed him to the contrary, that, "if one of the axles (provided six wheels are adopted) should break, the carriage would still rest on supporters, and continue its course." This would be true only in the contingency of the working axle being the one that failed. If either of the others gave way, the want of equilibrium, if not determined at once by the inequality of weights, would be quickly determined either by the *tug* of the engine or the *push* of the train, according as the one or the other of these causes was brought into action, through the failure of the fore or of the hind axle, as the case may be.

There is, however, one important point not yet cleared up, which is this: did the leading locomotive leave the rails in consequence of a failure occurring in any part of the engine, or in consequence of oscillatory motions ordinarily induced? The latter is the conclusion come to by your correspondent, and probably also by the French engineer whose investigations he has recorded; but it does not appear to me that the evidence is in favour of it, but leads rather to the opposite opinion. It must indeed be allowed, that the existence of very violent oscillations both vertical and lateral, *after* the engine left the rails, is unequivocally proved, by the alternate indentations of the wheels on the sleepers, and by the sinuous lines so traced. It must also be admitted, that this freedom of oscillation, and the measured correspondence of the indentations with the width of the wheels apart, are, both of them, incompatible with a complete fracture of either of the axles; or at least with any very deranged position of the wheels in consequence of it. It must be further admitted, that these oscillations could not have commenced all at once; and it *may* be admitted, that they existed some time previously to the locomotive leaving the rails, increasing gradually in violence to such an extent, as to induce M. Milhan to sound the alarm whistle, and Mr. George to apply the brake. But still the question arises, whether these were not the ordinarily induced oscillations, and not of themselves sufficient to have forced the engine off the rails? Whether in fact something else did not occur, in concurrence with, and perhaps also in aggravation of, these oscillations, to occasion the wheels to leave the rails? Now we know that the following incident occurred, possessing an aptitude to stand in the relation of a cause to the accident, whether it actually did so stand or not, namely, that Mr. George suddenly applied the brake immediately previous to its occurrence.

I endeavoured to show in a former article, (No. 981,) that the suddenness and force of this application may have thrown a stress of so instantaneous a nature on the axle, (not knowing at the time which axle had given way,) as to occasion its fracture, and that thus the disaster had occurred. Subsequent information, chiefly furnished by your correspondent, a "Practical Engineer," whilst it obliges me to modify, in some measure, this hypothesis, confirms, I think, its accuracy, as to the orgin of the accident being in the application of the brake. The fracture of the fore axle in two places is now amply accounted for, but the breaking of the driving axle is not so easily understood. It must either have been a mere casualty (another name for obscure causation and our own ignorance,) or it must have taken place at the overthrow of the engine; or it must have been produced by the brake. The first supposition is quite a chance, and unlikely to occur at a time when the working strain on the axle could not have been great; the second, also, is a very improbable occurrence, except so far as the shock and collision may have made a complete fracture of a previously crippled state of the axle; for it is particularly to be observed, that the axles, neither of the accompanying tender, nor of the six-wheeled engine and its tender, were broken in this melée. Besides, it is expressly stated in the report, that "the fracture appeared to have been produced by *torsion*." Only the third supposition, therefore, is probable, and it alone furnishes an adequate cause for the effect. There must have existed in some manner an obstacle to the rotation of the driving wheels, equal in its force of resistance to the power of producing torsion in the axle. Now I cannot conceive anything in the way of friction from the ground, or from carriages in contact, that could have furnished such resistance. Nothing but the means expressly provided in the brake, for putting a complete stoppage to the revolutions of the wheels, would be sufficient for the purpose.

It appears to me that the application of the brake operated in this manner:—At the same moment that an instantaneous strain was thrown on the driving axle, in the form of a retarding force to oppose the mass in motion, one of the cranks was with equal suddenness necessarily caught at, or very near to, a right angle with the connecting rod, and thus the steam being on, the axle was acted on by a double force, transverse and tangential, to the effect of both bending and twisting it at one end. Thus the appearance of torsion was produced, (and it is not an appearance likely to mislead), although the complete fracture it is probable only took place on the overthrow and collision of the engines. Neither could the axle have been much bent, otherwise the derangement of the wheel on that side would have been greater than it appears to have been; but it was sufficient, I conceive, to constitute that accessory circumstance, which in aid of the violent lateral oscillation, occasioned the wheels to surmount and leave the rails. It is easy to see how this effect would be produced, and how in the operation the rail on that side would be forced into "the very sinuous state" described by your correspondent, for the tendency would be, so to bend the axle at the journal on the side where the torsion took place, as to place the wheel at a slight horizontal diverging angle with the rail. Hence the indentations on the sleepers, (the wheel being retained in that position by the brake), would not be observably different from the proper distance of the wheels apart; hence also the increased inclination to run off the rails; and hence the *intermitting* sort of displacement of *one* rail only from the straight line, as the oscillatory movement upon it took place.

It appears also that the rail in this predicament was the right hand rail of the right hand line of rails, looking towards Versailles; and it might have been ascertained at the time, if that full investigation of the minutest particulars had been instituted, which the importance of the subject demanded: whether or not this was the rail which would be displaced, as corresponding to the position of the brake, if but one; or to the side on which Mr. George was standing, if there were two; or the crippled end of the axle, if, as is most likely, the crippling and ultimate fracture took place on one side. The several circumstances here noticed, combined and harmonised, strongly warrant the inference I have drawn, that the locomotive was forced off the rails by an accident supervening upon a state of oscillation; and that the origin of this accident, and

the manner of its operation, were such as are here described.

But the case will admit the further supposition, that the accident imparted additional force to the oscillatory motion, and therefore acted both directly and indirectly to carry the engine over the rails. It will also admit another supposition, that Mr. George—having brought the brake into action, and the axle having been twisted, and bent as before described, causing the wheel on that side to be thrown in some slight degree out of position—almost immediately afterwards released his hold upon it, and that thus the corresponding rail was at every revolution forced outwards, and consequently into that sinuous state described by your correspondent. This supposition might have been tested by measurements, showing whether or not the sinuosities coincided with the circumferences of the wheel. The case will further admit the possibility of the axle having been completely broken, if we suppose that the wheel with the shorter portion of the axle was kept stationary, and not greatly out of position, by the journals and by the *jamming* it received from the brake. In such a state of things, and the steam in the confusion not turned off, the oscillations would be very violent; for the engine would be urged against one rail, and take a rebound to be again urged and thrown off as before, until it overleaped the rails; and thus also in this way would only one rail receive damage in an intermitting manner, for the one-sided propulsive action would protect the rail on that side. The great weight of the six-wheel engine behind, probably enabled it to keep to the rails to the last, and would prevent the other from deviating greatly from the track.

Whatever may have been the exact course of the accident, the inference that the first event in the sad series was the application of the brake, and a consequent crippling or fracture of the driving axle, is, I consider, a matter of the highest probability. How this further operated to bring about the subsequent results, is more a matter of conjecture; but I have pointed out three modes in which they may have been produced, each consistent with the observed appearances, and quite adequate, in combination with a state of oscillation, to force the engine off the rails; but *after* this event, the occurrences are no longer conjectural. The indications are quite demonstrative, that the final event was the double breakage of the fore axle, and that it was occasioned by the concussive shocks it received, through the leaps and boundings of the engine over the sleepers. If, as hitherto considered, this event had been the first, it would also have been the last, for a necessarily immediate overthrow must have been the result; but all the appearances prove, however differently they may be interpreted, that time and distance were occupied in bringing about the catastrophe. The series of events, as I have given them, are, I think, just such as would with the greatest probability occur; they are in conformity with all the indications; and are consistent in order, with the comparative and with the relative strengths of the forces and resistances brought into collision.

I may probably in another communication take notice of some of the causes which occasion oscillation in railway engines and carriages; and also make some remarks on the ultra-scientific notion, which would trace the fracture of their axles to some occult electro and thermo-magnetic influences.

I am, yours, &c.

BENJAMIN CHEVERTON.

## MR. ZANDER'S TABLE OF THE PERFORMANCES OF VESSELS ABOVE BRIDGE—MR. ZANDER IN REPLY TO MR. BIRAM.

Sir,—I beg you will do me the favour to insert in your valuable Journal, a few remarks in reply to these of Mr. Biram, in your No. 1004, on my Tables of the performances of River Steam Vessels, (Nos. 1001 and 1002.)

In those Tables, and the accompanying remarks, it is clearly shown that 2¼ floats in each wheel may be immersed in the water, or 5 floats in the two wheels, which will be equal to an area of 25 square feet paddle surface, acting on the water. Mr. Biram thinks I am in error, in regarding only the immersed paddle-board surface "as *effective* paddle-board surface:" I will explain my reasons for doing so. When the wheel is in motion, one part of the paddle-board surface is

in the water, and the remaining part in the air; but as only that surface which is in the water serves to propel the vessel, I think it may very properly be called the "*effective* paddle-board surface."

I now come to a point very deserving investigation. What value, as an effective means of propelling a vessel, do these paddle-board surfaces possess? Or in other words, what useful resistance does the water oppose to these paddle-board surfaces, compared with what the same surfaces would experience if moved in a perpendicular direction? Mr. Biram will find that I have avoided giving any opinion on this question; seeing the disturbed state of the water in which the float moves, I regard the ordinary theory for calculating the useful effect of a paddle-wheel moved in the water, as being, if not useless, at least so complicated, that experiment alone can lead us to any correct practical conclusions on the subject. I have in my Tables given practical results only; I am convinced, that if other persons were to do the same, we should soon have such a collection of facts, formed under every variety of circumstances, as would enable us to deduce some certain rules for computing the useful effect of paddle-wheel surfaces. It is the more desirable to arrive at this knowledge as the proper proportion of the paddle-wheel to the vessel itself has so much influence in Steam Navigation.

Trusting that the preceding explanation may serve to remove the doubts entertained by Mr. B. of the correctness of my Tables,

I am, &c.

H. ZANDER.

Chelsea, November 9, 1842.

## THE WATER QUESTION.

Sir,—This present season of folly and philosophy, is signalized among other things, by a most vehement attack upon the Metropolitan Water Companies, as though the supplies they give us were the most poisonous and pernicious of all compounds and composites, and they themselves the greatest nuisances and nostrum-mongers that ever infected a well-ordered and self-satisfied community. It is remarkable that none of the condemners of Thames and New River water has suggested to the Companies to stop the supplies, even for one day, of their life-destroying commodity; but that they have all recommended only the straining of it through their own or their friends' filters, to prevent our stomachs being made the common sewer of all the impurities which are washed from millions of hands and backs in the great London (wash-hand) basin.

I believe that all this fuss has its chief origin in those baby-exhibitions of solar microscopes, whereby the Polytechnic proprietary, in their zeal to amuse the children-philosophers, have taught the grown-up babies also, that pure crystal water is nothing but a mass of moving life and ravenous ten feet monsters; which they have done by crowding the larvæ of gnats and flies, and other water insects from a quarter to half-an-inch in length, into the dirtiest ditch-water.

Now all this, however silly, is very harmless, so long as it is confined to flattering the conceit and furnishing the gossip of West-end philosophers; but I am very averse to have my constitution reformed, by such whiggery in water-drinking. I have lived a great part of my life for the last forty years in London, under the treatment of Sir Hugh Middleton; and finding myself still sound under his treatment, I am not particularly anxious to begin at this time to put myself under the new hydropathic system of the water-filterers,—who, by the way, I shrewdly and most *polytechnically* suspect, think that the pocket is a more vital part than the stomach in the human economy. I will mention one or two reasons why I fear, at this time, and upon this subject, to be over-philosophized.

Your correspondent, Mr. J. Cole, (in your 1002nd No. p. 398) says, "such small filters, by the slowness of the process, destroy the carbonic acid gas which is contained in the water, and without which it speedily becomes offensive, and putrid, and injurious to health." Of course, Mr. Cole cannot be a friend to Mr. Stuckey and his instantaneous electro-telegraphic filter; but it strikes me with surprise, that while all the water-reformers have been taking for granted, that pure filtered water was the only *elixir vitæ* and required condition of long life, there

should all at once start up a teacher—not one of their enemies either—who strikes a death-wound at their first premises, though so tenderly, it is true, that he, as it were, wounds them out of friendship. But the letting out of blood or water is not so easily stopped; and we are led at once to inquire,—if small filters abstract the carbonic gas entirely, may not more rapid filters do this mischief partially? And if one ingredient, carbonic gas, is a beneficial adulterater of the purity of water, may not some other of the component parts, which your correspondents propose to filter out, prove, after we have been disinfected of them, to have been equally beneficial? I will support this remark by an illustration, which, I hope, will serve to show that this subject of water-filtering is not quite such a matter-of-course subject, and that it is not quite so certain and axiomatic that the purest water that can be by any means obtained is the most salubrious beverage.

Your correspondent "A Subscriber," (in No. 1004, p. 430,) asks whether Mr. H.'s one-and-sixpenny filter "will take away the lime with which water, more or less, is impregnated, and which *must be* more or less prejudicial?" *Must* lime indeed be prejudicial more or less? Why so, Mr. Editor? Must the sand and gravel that birds swallow be the killing of them? Must the iron, and silex, and lime, and other earths which the roots of vegetables drink up, be the destruction, or the saving of them? Are not our bones made up of lime? And where, if not from our food or drink, is this material of our architectural composition to come from? I do not mean to philosophize, or to account for these things; but I merely mean to say that they are difficult and intricate, and deeper than "must be," which is the only argument I have seen for the half of these things; and that I only hope that my life may not be made the sport of half a dozen of these "must be" and "would be" philosophers.

Now, upon this subject of lime, a naval officer of experience was telling me, the other day, that they dare not give the *pure* rain-water which they catch from the skies to the sailors, for it would cause dysentery: *they are obliged to put lime into it* Bless me, Mr. Editor, what is become of our philosophers? I think I see them all tumbling head over heels, in their confusion and flight, like so many thousand Chinese men-at-arms, upon the visitation of a two-and-thirty-pounder. *They are obliged to put lime into it!* But the water-filterers say, that water cannot be *too* pure; and "A Subscriber" says, "the lime *must* be more or less prejudicial."

Now, thank goodness, Mr. Editor, I am still cockney enough to bless the name of Sir Hugh Middleton, and to think him one of the greatest benefactors of the human race, in a joint stock company way that has ever appeared. But since it is plain that we are not much longer to be suffered to use the undisintegrated water of the silver Thames and the chalk-fed* Lea, prepared in Nature's most perfect laboratory, I thank my stars that, by the blessing of Providence, guiding the hand and wit of man as its instrument, there are ample supplies of pump-water in all parts of London, (inaccessible to the approach of filterers,) from which I myself, and my neighbours too, (judging by the number of pitchers that are seen carrying about just before the hour of dinner,) are supplied with all the unboiled water which we drink.†

By the bye, Mr. Editor, no one of your correspondents has broached an essay upon the defecating process of boiling the water, which is so full of creeping things innumerable, and which process is so much in vogue already with all tea-drinkers, in street and alley, at the cost of an eighteen-penny tea-kettle. Do these monsters survive this hot-bathing system, and do they come out renewed in appetite and mischief, from this Neptuno-Plutonic process? One thing I have been used to hear, ever since I was taught philosophy and fudge by the nursery-maid, that, by the chemical process of boiling in tea-kettles, the carbonic acid gas is driven off, which holds the lime in solution, and the lime falls to the bottom of the containing vessel; and, from the deposit of what is

* The river Lea, from which the New River derives much of its water, as well as the New River Head, has its source chiefly in the chalk formation, from which, it is well known, the most transparent springs of any flow, at all times, and in all places where chalk prevails.

† The reader will find in the article which follows this, some additional reasons for doubting the surpassing virtues of *perfectly pure* water.—Ed. M. M.

called "fur" on the bottom and sides of the tea-kettle, I partly believe it is so. So, there goes the carbonic acid gas, which Mr. Cole wishes to preserve, and there goes the lime, which my naval friend has just popped in; and I am thinking that if the lime, in its descent, should just carry down all the monsters and creeping things, and what not—then, in that case, we shall have the very ocular realisation and antitype of the much-dubitated chalk formation before our eyes—constructed by the genuine Neptuno-Plutonic process — abounding in those curled and wriggling monsters which populate and characterise it—producing that pure, and purling, and delicious water, which flows every where from the foot of chalk rocks and the spouts of tea-kettles; and proving, most incontestably, the truth and true use of all the systems together of the geologists and the water-filterers.

I have the honour to be, Sir,

Your humble servant,

S. R. B.

November 22, 1842.

## ACTION OF WATER ON LEAD.

[Abstract of a paper by Professor Christison, read before the Royal Society of Edinburgh.]

The author showed the deleterious action of very pure water on lead, and that the purer the water, and the more free of salts in solution, the more powerful was its action on that metal. He mentioned one instance, in which the water was conveyed in a lead pipe from a distance of about three-quarters of a mile, from a spring of extraordinary purity, its total saline ingredients being only a 22,000th part. Here the water acted so powerfully on the lead, that in a short time the cistern in which the water was received was covered with loose carbonate of lead, and the metal could easily be detected in the state of oxide dissolved in the water.

In another instance, where the water was conveyed about half a mile, the same phenomena occurred; but with the additional circumstance, that, in consequence of the impregnation not having been detected in time, as in the previous case, the disease called *Colica Pictonum* broke out in the house supplied with the water. In this case the water contained no less than a 4500th part of saline matter, but chiefly muriates, which the author had previously found not to prevent the deleterious action unless present in much larger quantity.

The author then explained in what manner the action of the water on the lead was put an end to in both instances. In the first case the water was allowed to remain stationary in the pipe for four months, till a firm crust of mixed carbonate and sulphate of lead cystallized on the interior of the pipe, after which no farther action took place. In the second case the pipe was kept filled with a solution of phosphate of soda, consisting of a 27,000th of the salt.

He then stated the following practical conclusions to be drawn from his inquiries, as to the use of lead in conveying water:—

1. Lead-pipes ought not to be used for the purpose of conveying water, at least where the distance is considerable, without a careful chemical examination of the water.

2. The risk of a dangerous impregnation of lead is greatest in the instance of the purest water.

3. Water which tarnishes polished lead, when left at rest upon it in a glass vessel for a few hours, cannot be safely transmitted through lead pipes without certain precautions.

4. Water which contains less than about an 8000th of salts in solution cannot be safely conducted in lead pipes without certain precautions.

5. Even this proportion will prove insufficient to prevent corrosion, unless a considerable part of the saline matter consists of carbonates and sulphates, especially the former.

6. So large a portion as a 4000th, probably even a considerably larger, proportion, will be insufficient, if the salts in solution be in a great measure muriates.

7. In all cases, even though the composition of the water seem to bring it, within the conditions of safety now stated, an attentive examination should be made of the water, after it has been running for a few days through the pipes; for it is not improbable that other circumstances, besides those hitherto ascertained, may regulate the preventive influence of the neutral salts.

8. When the water is judged to be of a kind which is likely to attack lead pipes, or when it actually flows through them impregnated with lead, a remedy may be found, either in leaving the pipes full of the water, and at rest, for three or four months, or by substituting for the water a weak solution of phosphate of soda, in the proportion of about a 25,000th part.

## ON THE CONSTRUCTION AND USE OF COMMUTATION TABLES, FOR CALCULATING THE VALUES OF BENEFITS DEPENDING ON LIFE CONTINGENCIES.

### *Part IV.—On the Present Values of the Simple Benefits—continued.*

In the present paper we are to deduce the expressions for the present values of the assurance benefits.

Problem X.—To find the present value of an endowment assurance of £1 on $(x)$; that is, of £1 to be received $n$ years hence, provided $(x)$ shall have died in the preceding year, viz., in the $n$th year from the present time.

Of the $l(x)$ individuals, whose present age is $x$ years, represented by the mortality table to be now alive, $l(x+n-1)$ survive $n-1$ years, and $l(x+n)$ survive $n$ years. Consequently, $l(x+n-1) - l(x+n)$ is the number who die in their $n$th year; and it is also the number of pounds which will have to be paid, at the end of $n$ years, to the representatives of those who thus die. The present value of this sum, therefore, that is, the sum which, put out at interest now, would in $n$ years just amount to the first-named sum, is what must be advanced now to provide for this payment. This present value is $[l(x+n-1) - l(x+n)]v^n$. And since all the $l(x)$ individuals now alive are equally interested, all of them contribute equally to this amount. The contribution of each will be, therefore,

$$\frac{[l(x+n-1) - l(x+n)]\,v^n}{l(x)};$$

and this is the required present value.

As in Problem I., multiply the numerator and denominator of this expression by $v^x$, and it becomes

$$\frac{[l(x+n-1) - l(x+n)]\,v^{x+n}}{l(x)\,v^x}.$$

But the numerator of this expression is equal to $C(x+n-1)$, and the denominator to $D(x)$, by (1) and (3). Hence, the expression for the required present value, by the Commutation Table, is

$$\frac{C(x+n-1)}{D(x)}.$$

If $n=1$, that is, if the assurance is to be received a year hence, provided the death of $(x)$ take place in the present year, the expression becomes

$$\frac{C(x)}{D(x)}.$$

If $n=2$, it is $\frac{C(x+1)}{D(x)}$, and so on.

Example.—Required the present value of an endowment assurance of £1 on (30), provided he die in his 40th year.

Here $x=30$, and $n=10$. Hence, the present value is

$$\frac{C(39)}{D(30)}.$$

Since C is not exhibited, we may use for it either of the expressions (10) or (12). Taking the first, the formula becomes,

$$\frac{M(39) - M(40)}{D(30)} = \frac{540{\cdot}81079 - 522{\cdot}65022}{2257{\cdot}6521} = \frac{18{\cdot}16057}{2257{\cdot}6521} = {\cdot}008244 = 2d.$$

If the sum to be received be £100, its present value will be

$${\cdot}008244 \times 100 = {\cdot}8244 = 16s.\ 6d.$$

We have seen that when $n=1$, that is, when the sum assured is to be received a year hence, provided $(x)$ be then dead, the formula for the present value becomes

$$\frac{C(x)}{D(x)}.$$

But, by (12), $C(x) = v\,D(x) - D(x+1)$. Hence, by substitution, the formula in this case becomes

$$\frac{v\,D(x) - D(x+1)}{D(x)} = v - \frac{D(x+1)}{D(x)}.$$

And this expression affords a proof of the correctness of the formula in this problem. For, since $v$ is the present value of £1, to be certainly received a year hence, and $\frac{D(x+1)}{D(x)}$ is (by Problem I.) the present value of £1, to be received at the same time, provided $(x)$ be then alive, the difference between these two is evidently the present value of £1 to be received a year hence, if $(x)$ be then dead.

Problem XI.—To find the present value of a life assurance of £1 on $(x)$;

that is, of £1 to be received at the end of the year in which ($x$) dies, whenever that event may happen.

We saw, by the last problem, that $\frac{C(x)}{D(x)}$ is the sum which must be contributed now by each of the $l(x)$ individuals, to provide for the payment of £1 to the representatives of each of those of their number who die in the first year; and that $\frac{C(x+1)}{D(x)}$ is the sum each must contribute to provide for a like payment to the representatives of each of those who die in the second year. And in like manner by making $n$ successively equal to 3, 4, &c., to the end of life, in the formula deduced in last problem, we should obtain, for the amounts to be contributed now, to provide for the deaths that take place in the 3rd, 4th, &c., years respectively,

$$\frac{C(x+2)}{D(x)}, \quad \frac{C(x+3)}{D(x)}, \quad \&c.$$

And the sum of all these expressions is evidently the total sum which each of the $l(x)$ individuals must now pay to entitle his representatives to £1 at the end of the year in which he dies.

This sum is

$$\frac{C(x) + C(x+1) + C(x+2) + \&c.}{D(x)},$$

which, by (2), is equal to $\frac{M(x)}{D(x)}$; and this is, therefore, the required present value.

Example.—Required the present value of a life assurance of £1 on (20).

$$\text{Ans.} \quad \frac{M(20)}{D(20)} = \frac{1131{\cdot}76185}{3818{\cdot}9594} = {\cdot}296353 = 5s.\ 11d.$$

If the amount assured be £100, its present value will be,

$${\cdot}296353 \times 100 = 29{\cdot}6353 = £29\ 12s.\ 8d.$$

Problem XII. To find the present value of a deferred assurance of £1 on ($x$); that is, of £1 to be received at the end of the year in which ($x$) dies, provided that event take place after $n$ years.

The present value of this benefit, similar to that of the benefit in Problem III., is evidently equal to the sum of all the terms after the $n$th in the series of last problem, which expresses the present value of the same benefit for the whole life. This sum is, by (4),

$$\frac{M(x+n)}{D(x)};$$

which is, therefore, the present value required.

Example. Required the present value of an assurance of £1, deferred for 10 years, on (20).

$$\text{Answer.} \quad \frac{M(30)}{D(20)} = \frac{742{\cdot}95673}{3818{\cdot}9594} = {\cdot}194544 = 3s.\ 11d.$$

If the assurance be £100, its present value will be,

$${\cdot}194544 \times 100 = 19{\cdot}4544 = £19\ 9s.\ 1d.$$

Problem XIII. To find the present value of a temporary assurance of £1 for $n$ years, on ($x$); that is, of £1 to be received at the end of the year in which ($x$) dies, provided that event take place during the next $n$ years.

The present value here is evidently the sum of the first $n$ terms in the general series of Problem XI., which sum is, by (7),

$$\frac{M(x) - M(x+n)}{D(x)};$$

and this is therefore the present value required.

Example. Required the present value of a temporary assurance of £1 for the next 10 years, on (20.)

$$\text{Answer.} \quad \frac{M(20) - M(30)}{D(20)} = \frac{1131{\cdot}76185 - 742{\cdot}95673}{3818{\cdot}9594} = \frac{388{\cdot}80512}{3818{\cdot}9594} = {\cdot}101809 = 2s.$$

If the sum assured be £100 its present value is,

$${\cdot}101809 \times 100 = 10{\cdot}1809 = £10\ 3s.\ 8d.$$

If the present value just found be added to that found by the last problem, their sum, ·296353, is the present value of an assurance for the whole life, as found by Problem XI., which it evidently ought to be.

Problem XIV. To find the present value of a deferred temporary assurance of £1 on $(x)$; that is, of £1 to be received at the end of the year in which $(x)$ dies, provided that event take place in the $n$ years following the next $k$ years.

The present value required in this problem, is evidently the sum of $n$ terms of the general series of problem XI. beginning with the $(x+k)$th; which sum is, by (9), equal to

$$\frac{M(x+k) - M(x+k+n)}{D(x)};$$

and this is, therefore, the present value required.

Example. Required the present value of an assurance of £1 on (30), to be received at the end of the year of death, provided that event take place between the ages of 40 and 50.

Here $x = 30$, $k = 10$, and $n = 10$.

$$\therefore \frac{M(x+k) - M(x+k+n)}{D(x)} = \frac{M(40) - M(50)}{D(30)} = \frac{742{\cdot}05673 - 522{\cdot}65027}{2257{\cdot}6521}$$

$$= \frac{220{\cdot}30646}{2257{\cdot}6521} = {\cdot}097582 = 1s.\ 11\tfrac{1}{4}d.$$

If the sum sured be £100 its present value will be

$${\cdot}097582 \times 100 = 9{\cdot}7582 = £9\ 15s.\ 2d.$$

Problem XV. To find the present value of an increasing life assurance on $(x)$, which is to be £1 if death take place in the first year, £2 if in the second, £3 if in the third, and so on; the assurance increasing each year that the payment is deferred, by the amount of the first year's assurance, till the end of life.

The present value here is found exactly in the same way as that of the corresponding annuity benefit in Problem VI. For this assurance may be conceived to be made up of a series of assurances of £1, of which the first is to be entered upon immediately, and the others at intervals of one year, until the life shall have ceased to exist. The sum of the present values of all these assurances will evidently be the present value required. Now the present value of the first, is, by Problem XI. $\frac{M(x)}{D(x)}$; and of the second, third, fourth, &c., by Problem XII.,

$$\frac{M(x+1)}{D(x)},\ \frac{M(x+2)}{D(x)},\ \frac{M(x+3)}{D(x)},\ \&c.;$$

and the sum of all these, that is, the present value required in the problem, is, by (2),

$$\frac{M(x) + M(x+1) + M(x+2) + M(x+3) + \&c.}{D(x)} = \frac{R(x)}{D(x)}.$$

The same expression would be obtained by adding together the present values of the assurances for the separate years. Thus: the present value of £1 to be received at the end of one year, if death take place in that year, is, by Problem X., $\frac{C(x)}{D(x)}$; of £2 to be received at the end of two years, if death take place in the second year, $\frac{2\,C(x+1)}{D(x)}$; of £3 if death take place in the third year, $\frac{3\,C(x+2)}{D(x)}$, and so on. And the sum of these is, by (11), $\frac{R(x)}{D(x)}$ as before.

Example. Required the present value of an increasing assurance of £1, £2, £3, &c., on (30).

$$\text{Answer. } \frac{R(30)}{D(30)} = \frac{17127{\cdot}42459}{2257{\cdot}6521} = 7{\cdot}5866 = £7\ 11s.\ 9d.$$

Problem XVI. To find the present value of an increasing assurance, deferred for $n$ years, on $(x)$, which is to pay £1, £2, £3, &c., at the end of the year in which $(x)$ dies, according as that event shall take place in the $(n+1)$th, $(n+2)$th, $(n+3)$th, &c. year, from the present time.

By reasoning precisely similar to that employed in Problem VII., for finding the present value of the corresponding annuity benefit, and which it seems there-

fore unnecessary to repeat, the expression for the present value of the benefit in the present problem is found to be $\frac{R(x+n)}{D(x)}$.

Example. Required the present value of an increasing assurance of £1, £2, £3, &c., deferred 15 years, on (30.)

$$\text{Answer. } \frac{R(x+n)}{D\,x} = \frac{R(45)}{D(30)} = \frac{8326{\cdot}12414}{2257{\cdot}6521} = 3{\cdot}6890 = £3\ 13s.\ 9d.$$

Problem XVII. To find the present value of a temporary increasing assurance of £1, £2, £3, &c., for $n$ years on $(x)$. The solution of this problem is strictly analogous to that of Problem VIII., and the required present value is found to be,

$$\frac{R(x) - R(x+n) - n\,M(x+n)}{D(x)}$$

Example. $x = 30$, $n = 5$.

$$\text{Answer. } \frac{R(30) - R(35) - 5M(35)}{D(30)} = \frac{17127{\cdot}42459 - (13672{\cdot}73323 + 3099{\cdot}47060)}{2257{\cdot}6521}$$

$$= \frac{355{\cdot}22076}{2257{\cdot}6521} = {\cdot}15734 = 3s.\ 2d.$$

Problem XVIII. To find the present value of an arrested increasing assurance of £1, £2, £3, &c., on $(x)$; that is, of an assurance which is to be £1, if death take place in the first year, £2, if in the second year, £3, if in the third, and so on to the $n$th year, when the assurance will be £$n$, at which amount it is to continue for the remainder of life.

The present value here, by a mode of proceeding similar to that in Problem IX. will be found to be,

$$\frac{R(x) - R(x+n)}{D(x)}$$

Example. $x = 30$, $n = 5$.

$$\text{Ans. } \frac{R(x) - R(x+n)}{D(x)} = \frac{R(30) - R(35)}{D(30)} = \frac{17127{\cdot}42459 - 13672{\cdot}73323}{2257{\cdot}6521} =$$

$$\frac{3454{\cdot}69136}{2257{\cdot}6521} = 1{\cdot}5302 = £1\ 10s.\ 7d.$$

The foregoing comprise all of what may be called the *simple* benefits, and some (we mean the increasing benefits) which perhaps do not, in strictness, belong to that category. Previous to making a few general and miscellaneous remarks upon them, we present the following synoptical table of the results we have obtained. We omit, for brevity and distinctness, the common divisor D $(x)$.

| The present Value of an | To be received in $n$ years, is | For Life, is | For the first $n$ years, is | After the first $n$ years, is | For $n$ years after $k$ years, is | Uniform after $n$ years, is |
|---|---|---|---|---|---|---|
| Endowment of £1 on $(x)$... | $D(x+n)$ | | | | | |
| Endowment Assurance of £1 on $(x)$... .. | $C(x+n-1)$ | | | | | |
| Annuity of £1 on $(x)$......... | .............. | $N(x)$ | $\left\{\begin{matrix}N(x)- \\ N(x+n)\end{matrix}\right\}$ | $N(x+n)$ | $\left\{\begin{matrix}N(x+k)- \\ N(x+k+n)\end{matrix}\right\}$ | |
| Assurance of £1 on $(x)$...... | .............. | $M(x)$ | $\left\{\begin{matrix}M(x)- \\ M(x+n)\end{matrix}\right\}$ | $M(x+n)$ | $\left\{\begin{matrix}M(x+k)- \\ M(x+k+n)\end{matrix}\right\}$ | |
| Increasing Annuity of £1. £2, &c., on $(x)$ ... | .............. | $S(x)$ | $\left\{\begin{matrix}S(x)- \\ S(x+n)- \\ n\,N(x+n)\end{matrix}\right\}$ | $S(x+n)$ | $\left\{\begin{matrix}S(x+k)- \\ S(x+k+n)- \\ n\,N(x+k+n)\end{matrix}\right\}$ | $\left\{\begin{matrix}S(x)- \\ S(x+n)\end{matrix}\right\}$ |
| Increasing Assurance of £1, £2, &c., on $(x)$ | .............. | $R(x)$ | $\left\{\begin{matrix}R(x)- \\ R(x+n)- \\ n\,M(x+n)\end{matrix}\right\}$ | $R(x+n)$ | $\left\{\begin{matrix}R(x+k)- \\ R(x+k+n)- \\ n\,M(x+k+n)\end{matrix}\right\}$ | $\left\{\begin{matrix}R(x)- \\ R(x+n)\end{matrix}\right\}$ |

On looking at the expressions in the above table, the following analogies present themselves, attention to which wil prevent mistakes in practice. We con-

fine our remarks to the numerators, and it must be remembered that the denominator *in each case* is the D corresponding to the present age.

1. When a benefit for the whole life is to be entered upon immediately, the quantities in the numerator have for their signature the present age.

2. When the benefit is not to be entered upon immediately, the quantities in the numerator, (which, as regards the columns made use of, are the same as in the expressions for the corresponding benefits to last the whole life,) have for their signature the age at which the benefit is to be entered upon.

3. When the benefit is to be entered upon immediately, and to last for a term of years only, for example $n$ years, the expressions, as regards the uniform benefits, are derived from those for the same benefits to last the whole life, by writing $N(x) - N(x+n)$ and $M(x) - M(x+n)$, for $N(x)$ and $M(x)$, respectively; and, as regards the increasing benefits, by writing $S(x) - S(x+n) - n\,N(x+n)$ and $R(x) - R(x+n) - n\,M(x+n)$ for $S(x)$ and $R(x)$ respectively. If we write $S(x) - S(x+n)$ and $R(x) - R(x+n)$ for $S(x)$ and $R(x)$, we adapt the formulæ to the case in which the increase only is arrested at the end of $n$ years.

4. The expression for an annuity benefit is changed into that for the corresponding assurance benefit, by writing C, M, and R, for D, N and S, respectively, the signatures remaining the same, except in the case of C, the signature of which must be diminished by unity.

Since the expressions we have deduced are fractions, the terms of which consist of numbers in the Commutation Table all of the same dimension, none of them rising above the first degree, it follows that, if all the numbers in the table be either multiplied or divided by any one number whatever, the numerical values of the expressions will not be affected.

Hence the truth of the remark in the note, page 442, is established.

And hence also it follows, that the position of the decimal point in the Commutation Tables is perfectly arbitrary. The position assigned to it in our table, is that corresponding to a radix of the Mortality Table of 10,000, although the mortality actually made use of corresponds to a much higher radix, as stated in our first paper, p. 427.

The general problem solved in the preceding pages is, What is the *present value* of a benefit whose *amount* is £1? Suppose the problem reversed, and that it is required to find what *amount* of benefit is equivalent to a *present value* of £1? The following proportion evidently subsists in all cases: The present value of a benefit whose amount is £1, is to the present value of a like benefit of any other amount, as the amount of the first to the amount of the second. Hence, calling $a$ the present value of the first benefit, and £1 that of the second, we have, $a : 1 :: 1 : \frac{1}{a}$. That is, we should be furnished in each case with an expression which is the reciprocal of that which we have obtained for the present value of the same benefit when its amount is £1. Thus $\frac{D(x)}{N(x)}$ will be the amount, or annual rent, of a life annuity to be entered upon immediately, and $\frac{D(x)}{M(x)}$ the sum to be received at the end of the year of death, in consideration of a present payment of £1, by an individual now aged $x$ years. So also, $\frac{D(x)}{S(x)}$ will be the first, and $\frac{2\,D(x)}{S(x)}$, $\frac{3\,D(x)}{S(x)}$, &c., the second, third, &c., annual payments of an increasing life annuity whose present value is £1.

Hence the table on page 492, furnishes us also with a solution to the general problem in this form. For, to apply it to any particular case, we have only to form a fraction having for its *numerator* $D(x)$, and for its *denominator* the expression in the table corresponding to that case. But this belongs more properly to another branch of the subject.

Before concluding the present paper we make a remark, which perhaps might, with equal propriety, have been introduced elsewhere. It is as to the principle on which the preceding problems have been solved.

Each benefit consists of a payment or payments, to be made at a certain specified time or times, provided a state of things, also specified, shall then have place; such state of things being, where a single life is concerned, either the existence or the non-existence of that life,

coupled in the latter case with the farther condition, that its failure shall have taken place within a certain specified period. Problems I. and X. (using the former or the latter according as the first or the second of the states of things mentioned, is that on which the receipt of the benefit is made to depend) enable us to find the present value of the payment for any or each year of existence; and the sum of the present values for each year that the benefit is to last, is evidently the whole present value of the benefit. Thus, the present value of a life annuity of £1 is the sum of a series, whose terms express respectively the present value of £1 to be received at the end of one year, of two years, of three years, &c., from the present age to the end of life. The present value of an annuity of £1 to last *n* years, is the sum of the first *n* terms of the same series; and that of an annuity of the same amount, to be entered upon *n* years hence, and to last during the remainder of life, is the sum of all the terms after the *n*th.

The next paper will contain some examples of compound benefits.

G.

Hermes-street, Pentonville.

## CONSTRUCTION OF DOMESTIC STOVES.

Sir,—If you think the following remarks likely to produce any good end, perhaps you will be so good as to insert them in your next Number.

Your correspondent, R. W. T. complains that by the present construction of stoves, the smoke at the side and back of the fire passes away unconsumed for want of air, and thus heat is lost. Now this is only partially correct. No material will ignite till its temperature is raised to a certain degree, although ten times the needful quantity of air may be supplied; hence the rapidity of combustion when the iron plates around the fire become red hot, although but little more air is supplied than when the coal is first put on. The only difference is, that the oxygen is not consumed for want of heat, and this heat is better obtained and retained by having the back corrugated instead of perforated with holes for the admission of air, as suggested by R. W. T., and by upright instead of inclined sides and back, thereby giving more surface to the bottom. It is obviously useless, however, to encourage the consumption of fuel, by having the back part of the fire as brilliant as the front, unless the heat generated can be made available, and this cannot be done with grates as at present constructed. Three parts of it will be lost, either by being taken up with the passing air, or communicated to the iron and brickwork so far back that it cannot reach the front; so that, at the same expense more heat will be obtained by keeping a large fire, bright in front, but black behind. The remedy must begin with the grate; this might readily be done by having it somewhat like our common register stove, (the frame cast in one piece to prevent escape of gas,) but brought further into the room, and all that part now set in brickwork left exposed to warm the air. The fire should be lower down—the opening for the smoke at the back instead of the top—the front come down at least 6 inches below the opening, which should not exceed in dimensions 8 inches by 6. The ornamental part may be a matter of taste. A stove grate of this description will not require more than one half the usual consumption of coal with a comfort not shown in the use of the others.

I am, sir,

Your subscriber,

T. H. B.

## FENN'S IMPROVED COACH-WRENCH.

Sir,—The coach-wrench was doubtless on its first introduction peculiar to the manufacture from which it derived its name, but now there is scarcely another tool in more extensive employment. Hardly a workshop or manufactory can be visited (however small its complement of tools) in which the coach-wrench, or spanner, does not play an important part. As hitherto made, however, these implements have been sadly defective, arising partly from the principle upon which they have been constructed, but more particularly from the inferiority of their workmanship, being got up so as to meet the ever constant cry of—"cheap, cheap!"

Some attempted improvements in screw-wrenches have formed the subject of one or more recent patents, but these fall into insignificance before the great improvement achieved in this article by Mr. Fenn, whose novel coach-wrench has

been described at page 391 of the present volume. To this description, I now beg to add a few remarks, in order to set the importance of Mr. Fenn's invention more fully before your readers.

All previous coach-wrenches have consisted of a stem, with one fixed and one moveable cheek or jaw, capable of being set and held at certain distances, according to the size of the bolt or nut to be acted upon; the moving power has ever been a screw, but applied in a great variety of ways. Even when well made, the threads of this screw, after a time, become worn and strip, while in those of the ordinary description this effect very rapidly obtains. Again, with the screw-wrench, when nuts, varying greatly in size, are employed (which is a frequent occurrence) the setting of the wrench to each is a slow and tedious operation, and the continual working of the screw causes most injurious wear of its threads.

In Mr. Fenn's new coach-wrench, no matter how great the discrepancy between the sizes of the nuts, &c., the adjustment is instantaneous, without strain or wear to any part of the instrument. The wedge being free, the jaw A (*vide* page 391,) is placed against one side of the nut, and the jaw C slips up against the other; on grasping the handle and lever to turn the nut, the jaw C becomes immediately fixed in its position. When the nut is screwed up, the jaw is released by letting go the lever.

The defects and inconveniences of the ordinary coach-wrench have led, in a number of instances, where the work will admit of it, to the employment of spanners of definite fixed sizes, such as half inch, inch, and so forth.

Mr. Fenn's recent improvement, however, has so completely turned the tables in this matter, that *his* coach-wrench will really be found to be the best, and by far the most convenient that can be employed: inasmuch as it can be applied to nuts of every size within its range (about 4 inches) in less time than one of the particular size required could be selected, supposing it lay before the workman, instead of having, as is often the case, to be sought for.

I am sure your correspondent "T. B. J." will not take it amiss at my adding this testimony to his own, in behalf of the merits and advantages of this simple but really beautiful contrivance of Mr. Fenn's, which only requires to be known to be duly appreciated.

I remain, Sir,

Yours respectfully,

WM. BADDELEY.

29, Alfred-street, Islington.
November 9, 1842.

## MOSELEY'S MECHANICAL PRINCIPLES OF ENGINEERING AND ARCHITECTURE.*

The object of the present volume, by the learned Professor of Philosophy and Astronomy in King's College, is to apply the principles of mechanics to the investigation and solution of the most important and obvious of those questions which present themselves in the practice of the engineer and architect; and it is by far the most original, ingenious, and useful work which has yet appeared on the subjects which it embraces.

The author first treats briefly of those portions of Statics on which the "theory of machines" and "theory of construction" depend, namely, the "parallelogram of pressures"—the "equality of moments"—the "polygon of pressures"—the "parallelopipeds of pressures"—"parallel pressures"—and the "centre of gravity." The term *pressure* Professor Moseley employs in preference to the ordinary one of *force*; but the difference between them is not very perceptible. Granted, that there is no force till there is pressure; still, the substitution of the one term for the other is but another form of expressing that it is pressure which constitutes force. Indeed, the Professor himself afterwards admits as much, when he says, (Note p. 92,) that "pressure and moving force are but different modes of the operation of the same principle of force."

We are next introduced to Dynamics, or that science which "treats of the laws which govern the motions of material bodies, and of their relation to the forces whence those motions result." Various terms have been used to denote the result of the union of a continued pressure or force with a continued

* The Mechanical Principles of Engineering and Architecture. By the Rev. Henry Moseley, M.A., F.R.S., Professor of Natural Philosophy and Astronomy at King's College. With Illustrations on Wood. 8vo., pp. 627. Longman and Co.

motion; such as *dynamical effect, efficiency, quantité d'action, puissance mécanique*, &c. But, among our French neighbours, all other terms have lately given place to the word *travail;* and as this has the advantage of great clearness, distinctness, and simplicity, Professor Moseley proposes that we shall follow their example, and make use of the analogous English term, *work.* The propriety of this recommendation is so obvious, that we make no doubt it will be henceforth universally adopted.

The "work" of overcoming a pressure of one pound through a space, of one foot has, in this country, been considered as the *dynamical unit*, or term in which any other amount of work may be estimated; and in France, the "travail" of overcoming a pressure of one kilogramme through a space of one metre has, on the suggestion of M. Dupin, been called a *dyname.* Professor Moseley thinks "*unit of work*" a better term than dyname; and here, again, we think the universal scientific world will go along with him.

For *dynamical effect* and *dynamical unit*, therefore, let the terms *work* and *unit of work* be henceforth and for ever substituted; and let the engineering student, who desires to start with clear notions of the elements he has practically to deal with, commit to memory the following definitions.

"*Work* is the union of a continued pressure with a continued motion. A mechanical agent is thus said to work when a pressure is continually overcome, and a point (to which that pressure is applied) continually moved by it. Neither pressure nor motion alone is sufficient to constitute *work;* so that a man who merely supports a load upon his shoulders, without moving it, no more *works*, in the sense in which the term is here used, than does a column which sustains a heavy weight upon its summit."—Page 53.

"*The unit of work* is the work necessary to overcome a pressure of one pound through a distance of one foot, in a direction opposite to that in which the pressure acts. Thus, for instance, if a pound weight be raised through a vertical height of one foot, one unit of work is done; for a pressure of one pound is overcome through a distance of one foot, in a direction opposite to that in which the pressure acts."—Page 54.

It will be proper further to bear in mind, that by the pound mentioned in these definitions is to be understood the weight of 22·815 cubic inches of distilled water at 62° Fahr., (with barometer at 30 in.,) which is equal to 5,760 grains, or 1 lb. troy, and 7,000 grains, or 1 lb. avoirdupois.

Newton employed the term *vis inertiæ* to express the inert or passive force which any body opposes to motion; and this term has continued in very general use down to the present day. But as it would be obviously inconsistent with the preceding definitions, to recognize the existence of force (*vis*) where there is no motion—no pressure—no work done (dynamically considered)—Mr. Moseley abandons the use of that term altogether; and endeavours to make up for it by the following new enunciation of the principle of the *vis viva*, or moving force.

"The difference between the aggregate work done upon the machine, during any time, by those forces which tend to accelerate the motion, and the aggregate work, during the same time, of those which tend to retard the motion, is equal to the aggregate number of units of work accumulated in the moving parts of the machine during that time, if the former aggregate exceed the latter, and lost from them, during that time, if the former aggregate fall short of the latter."—Page 9.

We submit that this is but avoiding one inconsistency, to fall into a greater. The learned Professor has taught us, before, that "a man who merely supports a load upon his shoulders, without moving it, no more *works*, in the sense in which that term is here used, than does a column which sustains a heavy weight upon its summit;" and yet, he here speaks of the "*aggregate work*" done by certain "forces," which are of just as passive a character as either the man or the column. It cannot be said that any thing is gained, either in exactness or clearness, by calling the motion obstructive property, which bodies in a state of rest possess, a force which "tends to retard motion," instead of *vis inertiæ.* The thing itself remains, though the old definition be shelved.

Neither can it be considered correct to say, that the active forces are those which merely "*tend* to *accelerate* motion," for

they *cause* it as well. And this is consistent with the definition given elsewhere by Mr. Moseley himself (Part I., p. 1) of the term "force," namely, that "force is that which tends to cause or to destroy motion, or which actually causes or destroys it."

The word *inertia*, (an obvious abbreviation of *vis inertiæ*,) has come into such common use amongst us, that it may almost be considered as adopted into our vernacular tongue; and it conveys so intelligibly to every one the thing meant by it, that we think it a waste of labour and ingenuity to go farther a-field in search of a better.

The "work of pressures applied in different directions to a body movable about a fixed axis;" the "moment of inertia;" the "acceleration of motion by given moving forces"—the "descent of a body upon a curve"—the "simple pendulum"—"impulsive force"—"the parallelogram of motion"—"the polygon of motion"—"the principle of d'Alembert," (that in any system of bodies mechanically connected in any way, so that their motions may mutually influence one another, if forces equal to the effective forces were applied in directions opposite to their actual directions, there would be an equilibrium with the impressed forces)—the "motion of translation"—"the motion of rotation about a fixed axis"—"the centre of percussion"—"the centre of oscillation"—"projectiles"—"centrifugal force"—the "principle of virtual velocities"—"the principle of *vis viva*," (before adverted to,)—are all successively treated of as branches of dynamics, and with great ability, though in a more scholastic style, (of which more hereafter,) than seems to us absolutely necessary.

We come now to what has been so long a sort of *opprobrium mechanicum*, the subject of *friction*, and shall first present to our readers Mr. Moseley's definition of it.

"It is a matter of constant experience, that a certain resistance is opposed to the motion of one body on the surface of another under any pressure, however smooth may be the surfaces of contact, not only at the first commencement, but at every subsequent period of the motion; so that, not only is the exertion of a certain force necessary to cause the one body to pass *at first* from a state of rest, to a state of motion upon the surface of the other, but that a certain force is further requisite to *keep up* this state of motion. The resistance thus opposed to the motion of one body on the surface of another, when the two are *pressed* together, is called friction; that which opposes itself to the transition, from a state of continued rest to a state of motion is called the *friction of quiescence*; that which continually *accompanies* the state of motion is called the *friction of motion*."—p. 137.

To this definition, there is this insuperable objection, that it rests on an assumption which in point of fact is *not true*. *All friction* is not *all resistance* to motion; for without friction there would in many cases be *no motion*. On railways, for example, and in such hydraulic machines as the "Danaide," or Whitelaw and Stirrat's mill, if we were to take away Mr. Moseley's "certain *resistance*" to motion, there would be no motion at all! Innumerable would be the similar paradoxes in which such a definition would involve us. Something better in the way of definition undoubtedly remains yet to be worked out.

But *till all the facts about friction* have been incontrovertibly ascertained, it would be idle to hope for any complete definition, and this assuredly has not yet been done. The following summary by Mr. Moseley of the "principal facts" which have resulted from the experiments made on friction, all of them, be it observed, of a very recent date, is excellent in its way; but when the professor adds that "*they* constitute the laws of friction," he evidently goes further than he is warranted by his premises. He says himself afterwards, (p. 144,) "it is *to be regretted* that with the means so munificently placed at his disposal by the French Government, M. Morin did not extend his experiments to higher pressures," &c. Why regretted, if "*the laws of friction*" have been already established?

"The principal experiments on friction have been made by Caulomb, Vince, G. Rennie, N. Wood, and recently (at the expense of the French Government) by Morin. They have reference, first, to the relation of the friction of quiescence to the friction of mo-

tion; secondly, to the variation of the friction of the same surfaces of contact under *different pressures;* thirdly, to the relation of the friction to the *extent* of the surface of contact; fourthly, to the relation of the amount of the friction of motion to the velocity of the motion; fifthly, to the influence of unguents on the laws of friction, and on its amount under the same circumstances of pressure and contact. The following are the principal facts which have resulted from these experiments; they constitute the *laws* of friction.

"1st. That the friction of motion is subject to the same laws with the friction of quiescence, (about to be stated,) but agrees with them more accurately. That, under the same circumstances of pressure and contact, it is nevertheless different in amount.

"2ndly. That when no unguent is interposed, the friction of any two surfaces (whether of quiescence or of motion) is directly proportional to the force with which they are pressed perpendicularly together, (up to a certain *limit* of that pressure per square inch); so that, for any two given surfaces of contact, there is a constant ratio of the friction to the perpendicular pressure of the one surface upon the other. Whilst this ratio is thus the same for the same surfaces of contact, it is different for different surfaces of contact. The particular value of it in respect to any two given surfaces of contact is called the co-efficient of friction in respect to those surfaces. The co-efficients of friction in respect to those surfaces of contact, which for the most part form the moving surfaces in machinery, are collected in a Table.*

"3rdly. That when no unguent is interposed, the amount of the friction is, in every case, wholly independent of the *extent* of the surfaces of contact, so that the force with which two surfaces are pressed together being the same, and not exceeding a certain limit (per square inch) their friction is the same whatever may be the extent of their surfaces of contact.

"4thly. That the friction of motion is wholly independent of the velocity of the motion.

"5thly. That where unguents are interposed, the co-efficient of friction depends upon the nature of the unguent, and upon the greater or less abundance of the supply. In respect to the supply of the unguent, there are two extreme cases, that in which the surfaces of contact are but slightly rubbed with the unctuous matter, and that in which, by reason of the abundant supply of the unguent, its viscous consistency, and the extent of the surfaces of contact in relation to the insistent pressure, a continuous stratum of unguent remains continually interposed between the moving surfaces, and the friction is thereby diminished, as far as it is capable of being diminished, by the interposition of the particular unguent used. In this state the amount of friction is found (as might be expected) to be dependent rather upon the nature of the unguent than upon that of the surfaces of contact; accordingly M. Morin, from the comparison of a great number of results, has arrived at the following remarkable conclusion, easily fixing itself in the memory, and of great practical value; 'that with unguents, hogs' lard, and olive oil, interposed in a continuous stratum between them, surfaces of wood on metal, metal on wood, and metal on metal, (when in motion,) have all of them very nearly the same co-efficient of friction, the value of that co-efficient being, in all cases, included between 0·7 and 0·8.'

"'For the unguent tallow, the co-efficients are the same as for the other unguents in every case, except in that of metals upon metals. This unguent appears, from the experiments of Morin, to be less suited to metallic substances than the others, and gives for the mean value of its co-efficient, under the same circumstances, 10.'"

* This Table we shall give at length at some future opportunity.—Ed. M. M.

The points which most want clearing up are these:

1. What the "certain limit," or pressure per square inch is, at which the friction of any two surfaces ceases to be in a constant ratio to the force with which they are pressed perpendicularly together.

M. Morin's experiments (from which chiefly the preceding "laws" are deduced) were made with insistent pressures of only from 14·3 to 28·6 lbs. per square inch; but the experiments of Mr. George Rennie, which were carried in some instances to as high as 5 and 7 cwt. per square inch, show that the co-efficient of the friction of *quiescence* increases rapidly as the pressure advances to the point at which the substances begin to abrade or destroy one another, though at what particular stage that increase begins, and in what ratio it proceeds, has yet to be ascertained. Professor Moseley thinks it probable that the coefficient of the friction of *motion* remains constant under a wider range of pressure than that of quiescence; but this also is a point which future experiment only can determine.

2. How far the approach to the point of abrasion or destruction is accelerated by the velocity of the moving surface (that it is accelerated to some unknown extent appears certain), and what the amount of destruction of surface, or wear of material is, which corresponds to the same space traversed under different pressures, and at different velocities.

The "limiting angle of resistance" is a very appropriate name first given by Mr. Moseley to that particular degree of inclination from the perpendicular at which one body, moving on another fixed body, will cease to be sustained by it; and its properties were also first investigated by him in a paper read before the Cambridge Philosophical Society, in December, 1833, and published in the Transactions of the following year. The results of that enquiry are here given in a condensed, but sufficiently intelligible form; besides which the author has been at the pains to calculate the value of that angle in respect of every one of the numerous surfaces contained in the Table of Friction before alluded to, as intended to be presented to our readers *in extenso* at some future opportunity.

The "Theory of Machines," which comes next, occupies by far the largest portion of the volume, and is beyond all doubt, the most valuable, and important.

In a memoir by Mr. Moseley, "On the Theory of Machines," which was published in the Philosophical Transactions for 1841, he showed that the moving power in every machine divides itself into, First, that which overcomes the prejudicial resistances (the *vis inertiæ*); Second, that which causes the progression of the machine, or accumulates power in it; and Third, that which operates at the working point or points, and is represented by the work done by it. Mr. Moseley showed also, that between these three elements there obtains in every machine a mathematical relation which he called its *modulus*. Now what the learned Professor has done in the part to which we are now come of the present volume, is to determine the particular moduli of all the ordinary elements of machinery, as the wheel and axle, cord and pulley, rack and pinion, &c.; so that when we wish to ascertain the modulus of any machine, we have but to combine the moduli of all the elements of which it is compounded.

Of these elements, the most frequent in occurrence, as well as the most useful in application, are those which rotate about cylindrical axes; and in treating of these the author is particularly happy. We may select, for example, two passages relating to that often and still much debated question, the comparative merits of the beam and direct action steam-engines, which ought, in our humble judgment, to set that question at rest for ever.

Article 168. "*A machine to which are applied any two pressures* $P^1$ *and* $P^2$, *and which is moveable about a cylindrical axis, is worked with the greatest economy of power, when the directions of the pressures are parallel, and when they are applied on the same side of the axis, if the weight of the machine itself be so small that its influence in increasing the friction may be neglected.*

"For, representing the weight of such a machine by W, it appears by equation (166) that the modulus is

$$U^1 = U^2 \left\{ 1 + \frac{\rho L}{a^1 a^2} \sin. \phi \right\};$$

when it follows that the work $U^1$ which must be done at the moving point to yield a given amount $U^2$ at the working point is less as L is less.

Fig. 1.

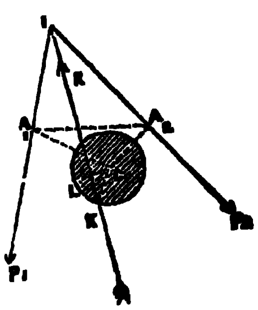
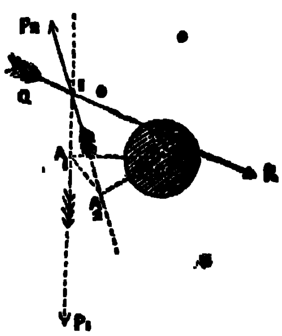


Fig. 2.



"Now L represents the distance $A^1 A^2$ between the feet of the perpendiculars $C A^1$ and $C A^2$, which distance is evidently least,

when $P^1$ and $P^2$ act on the same side of the axis as in fig. 2, and when C $A^1$ and C $A^2$ are in the same straight line; that is, when $P^1$ and $P^2$ are parallel.

* * * * * *

"261. It has already been shown (article 168) that a machine working like the beam of a steam-engine under two given pressures about a fixed axis is worked with the greatest economy of power when both these pressures are applied on the same side of the axis. This principle is manifestly violated in the beam-engine; it is observed in the engine worked by Crowther's parallel motion, (as used in the mining districts of the north of England,) *and in the marine engines recently introduced by Messrs. Seaward, and known as the Gorgon engines.* It is difficult indeed, to defend the use of the beam on any other legitimate ground than this; that in some degree it aids the fly-wheel to equalize the revolution of the crank arm,* an explanation which does not extend to its use in pumping engines, where, nevertheless, it retains its place; adding to the expense of construction, and by its weight greatly increasing the prejudicial resistances opposed to the motion of the engine."

On the subject of "wheels," the author appears also to especial advantage. The direction of the vertical pressure of the teeth is determined by a method first applied by him to that purpose in his popular treatise, entitled "Mechanics applied to the Arts," 1834. In determining the moduli of different systems of wheels, he takes into account, not only the friction of the teeth, but that of the axes and weights of the wheels; and in the case of epicycloidal and involute teeth, the modulus assumes such a character of mathematical precision as incontrovertibly to establish the important practical conclusion (so often disputed) that the loss of power is greater *before* the teeth pass the line of centres, than *at corresponding points* afterwards; but that, nevertheless, the contact should in all cases take place partly before, and partly after the line of centres has been passed. In the case of involute teeth, the proportion in which the arc of contact should thus be divided by the line of centres is determined by a simple formula; as are also the best dimensions of the base of the involute, with a view to the most perfect economy of power in the working of wheels.

*(To be continued.)*

* The reader is referred to an admirable description of the equalising power of the beam, by M. Coriolis, contained in the 13th vol. of the *Journal de L'Ecole Polytechnique.*

## ON THE COMPARATIVE EXPENSE OF LIGHT DERIVED FROM DIFFERENT SOURCES, AND ON THE USE OF CHLORINE AS AN INDICATION OF THE ILLUMINATING POWER OF COAL GAS. BY ANDREW FYFE, M.D., F.R.S.E., F.R.S.S.A., &c.

[*From the Transactions of the Royal Scottish Society of Arts, Session* 1841—2.]

In a paper published in the *Edinburgh Philosophical Journal* for 1824, I recommended the condensation of the heavy hydro-carbons by chlorine, as an easy and efficacious method of ascertaining the comparative illuminating power of coal-gas, while, at the same time, it had the advantage of enabling us to compare one gas with another, though not brought directly into contrast with it, and thus, by fixing on one as a standard, to state the illuminating power numerically.

With regard to the methods now in use, I mean the specific gravity, the quantity of oxygen necessary for combustion, and the depth of shadow, the last is the only one in which we can place any confidence. As to the specific gravity, if the gas be pure, that is, free from carbonic acid and sulphuretted hydrogen, then the heavier it is the more likely is it to be of high illuminating power; but this is not always the case: thus the specific gravity of olefiant gas and of carbonic oxide is the same, but the latter burns with a feeble blue flame, whereas the former gives forth a brilliant light. Now, suppose coal-gas to contain little of the heavy hydro-carbon, and a large proportion of carbonic oxide, then the specific gravity may be such as to induce us to expect the illuminating power to be high, when in fact it is not.

The same remark is applicable to the mode of testing by the quantity of oxygen necessary for complete combustion. A gas with much olefiant will no doubt require much oxygen, this gas taking no less than thrice its own bulk; but let us suppose a variety of gases to have the same proportion of olefiant or of heavy hydro-carbons, while the proportion of the other inflammable gases varies, which, though they consume oxygen, give out little light during their combustion, and we shall find that the amount of oxygen required gives no indication whatever of the illuminating power.

Thus, suppose the composition to be—

| | | | |
|---|---|---|---|
| Olefiant | 13 | 13 | 13 |
| Carburetted hydrogen | 83 | 65 | 51 |
| Carbonic oxide | 4 | 14 | 8 |
| Hydrogen | 0 | 8 | 28 |
| | 100 | 100 | 100 |

the first would require 207, the second 180, the third 159, of oxygen, yet the illuminating power would be nearly the same in all. Supposing the heavy hydro-carbons to vary, and even to become considerable, yet the quantity of oxygen may not be in proportion, owing to the hydrogen and carbonic oxide, which require only half of their bulk of that gas for combustion. The mode of ascertaining the illuminating power by the shadow is one in which we may place the utmost reliance, provided we burn the gases with the same kind of burners, and pay particular attention to the circumstances affecting the appearance of the shadow; for it is well known that the colour of the shadow varies even from the same gas, when the flames from different burners are contrasted; besides, the reflection of light from surrounding objects will also occasion a difference. Great care is therefore necessary when conducting the trials in this way; and it requires nicely adjusted meters, and a regular pressure, so that the consumpt shall not vary during the performance of the experiment.

The other method which I formerly recommended is not liable to these fallacies. In the paper to which I have already alluded the results of numerous trials are given, in which the illuminating power, as shown by the chlorine test, very nearly agrees with those indicated by the photometric process; and these experiments were performed with every possible attention to the circumstances likely to affect the results, *so far as they were then known*. In a paper subsequently published by Drs. Christison and Turner, the accuracy of the chlorine test was called in question, partly because, when testing the gases by the photometric process, as pointed out by Rumford, due attention was not paid to the different circumstances affecting the combustion, and partly owing to the opinion expressed in the paper by the authors, that other ingredients than olefiant exist in coal-gas, which afford light by their combustion, and which are also condensible by chlorine. As to the latter objection it is of little value, provided we find the results indicated by the chlorine test, to agree with the photometric one. With regard to the latter, it must be admitted, that in some of the trials, where two gases were compared with each other, due attention was not paid to the height of the flame, and to the other circumstances affecting the combustion, which, at the time that I was engaged in the enquiry, were not known to have an influence on the illuminating power. The influence of these has now been fully investigated, and made known, in the paper by Drs. Christison and Turner, and also in that which I read to the Society in 1840. Since then, I have again had my attention drawn to the subject, and have had many opportunities of putting the chlorine method to the test of experiment; and I must say that I am more and more inclined to put the most implicit confidence in it, not only as a very simple, but at the same time a correct method of ascertaining the comparative illuminating power. I trust the results of the trials will not be devoid of interest.

In fixing the illuminating power of the gases by the shadow, two accurately adjusted meters were used, one for the one gas, the other for the other. Sometimes the gases were contrasted with each other; in which case, similar burners, consuming the gas under the same circumstances, were employed; and with the view of securing accuracy in the results, the burners were sometimes changed from one gas to another; at other times, the light given by the gas was contrasted with that from candles. The gases subjected to trial were sometimes those with which Edinburgh is at present supplied, sometimes they were prepared by myself, in a small apparatus, with the view of having the illuminating power as varied as I could possibly obtain.

It is well known that the quality of coal-gas, even when manufactured from the same kind of coal, depends much on the mode of manufacture; when slowly prepared, and when the same charge of coal is long subjected to heat, a larger quantity of gas is given off, than when the time for the charge is shorter; but then the illuminating power is low, owing to the gas which is last evolved having very little of the heavy hydro-carbons; and hence those companies who dispose of their coke to advantage, have, besides the quantity of gas to be got, another object in view, viz., the freeing of the coke from all its gaseous ingredients, otherwise it is not considered valuable, indeed will not be purchased by those in the custom of using it. It is this which, in addition to the difference in the quality of the coal employed, makes such a difference between the quality of gas prepared in England and Scotland; for, as the coke from English caking-coal is more prized than that from parrot-coal, which is much used in Scotland, the English companies may generally be considered not only as gas

companies, but also as coke companies, indeed derive a great deal of their profit from the coke. Hence, in judging of the price of gas, we must take into account its quality; and hence, I conceive, the importance of having an easy method of ascertaining this, and of comparing different gases with each other.

In the first series of experiments, the results of which I am now to give, two gases, manufactured under different circumstances, were compared with the light afforded by a wax candle kept burning, as nearly as possible with a uniform flame; the gases being consumed in jet burners with a 5-inch flame. Taking the average of several trials, gas A gave a light as 2·16, compared to that of the wax-candle as 1; the condensation by chlorine was 15. Gas B, under similar circumstances, gave a light as 1·98; condensation by chlorine 13, and 15 : 13 : : 2·16 : 1·86; by the shadow it was 1·98.

In another trial with other gases the light was compared with that afforded by a *tallow* candle (short six.) Gas C, the light was as 2·81, to that of the candle as 1; condensation by chlorine 15. Gas D, the light was 2 27, chlorine test 12,

and as 2·81 : 2·27 : : 11 : 8·02
and as 15 : 13 : . 1 : 8·00,

which is a very close approximation.

Two gases were next contrasted with each other being consumed with fish-tail burners. By the shadow the light for equal consumpt was 1 to ·827, by the chlorine, 14 : 12, and as 14 : 12 : : 1 : ·857. In another trial with the same burners, but with gases prepared at another time, the average of numerous trials by the photometric process, gave the result as 1 to ·945; condensation by chlorine was 12·5 and 11·5, and as 12·5 : 11·5 : : 1 : ·92.

With jets and with other gases, the results were by the shadow 1 to 1·185, and by chlorine 11 to 14, and 11 : 14 : : 1 : 1·272. Here the approximation is not so close as in some of the others.

The chlorine test was then tried with a gas, the illuminating power of which was inferior to that of the preceding. The trial by the shadow was made at different distances, to secure accuracy. By the one the result was as 1 to 1·347, by the other to 1·338, average 1 to 1·342. The condensation by chlorine was 10 and 14, which very nearly coincides with the others.

The results above stated, very nearly agree with each other. In one trial, however, I found that they did not come so close. By the shadow they were 1 to 1·33, by the chlorine 11 to 17, now as 11 : 17 : : 1 : 1·54.

In this instance the discordance may, I think, be accounted for. It is well known that when the illuminating power of a gas is high, as when it is prepared by the decomposition of oil, it requires a burner with smaller apertures than those used for common coal-gas, otherwise it is not consumed to advantage. Now, in the experiment last recorded, in which the condensation by chlorine amounted to 17, a coal-gas jet was used, by which the gas would not give the same amount of light that it would have given, had a burner with smaller apertures been employed. Hence the illuminating power indicated by the shadow does not come up to what most likely it would have been with a differently constructed burner. May not this exception prove the accuracy of the proposed test?

From what has now been said with regard to the test which I have proposed, I think we are warranted in placing implicit confidence in it, as a means of indicating the illuminating power of coal-gas; indeed I have no hesitation in stating, that when the trial is properly conducted, it leads to results more satisfactory than those given by the shadow; for it has this advantage, that while it is much more easily conducted, it points out the amount of light that ought to be afforded by one gas as compared with another; whereas, unless all the different circumstances that affect the combustion of the gases are attended to, the results by the shadow will not be correct. One of them, in particular, is the kind of burner,—for when gas is rich in matter condensible by chlorine, and a common coal-gas burner is used, the illuminating power indicated by the shadow will, most probably, be below what it really is, owing to the burner not being adapted for the combustion of that peculiar kind of gas; and hence one of the advantages of the chlorine test.

The process practised in the experiments I have detailed is, with a slight modification, the same as that formerly described. Two tubes of about half an inch in diameter, and 12 inches long, of the same calibre, and graduated to 100 parts, are employed; into the one 50 degrees of the gas under investigation are introduced, and afterwards into the other there are put 50 of chlorine; the water of the trough being heated to 50, or thereabouts. The coal-gas is then transferred into the chlorine, and the tube instantly covered with a shade, to prevent the action of the light. In the course of five minutes, the condensation is complete. Should only one graduated tube be used, the coal-gas must be measured first, and then put into another tube, after which the chlorine is measured, and the *coal-gas transferred* into it; for, if otherwise, a part of the

chlorine would be absorbed by the water, during its passage through it, and thus lead to variable results. As chlorine is absorbable by water, a slight absorption takes place during the continuance of the experiment. Before proceeding to any trials, it is therefore necessary to ascertain the amount of this, and then to deduct it from the condensation occasioned by the action on the coal-gas. In the tube which I have used, I found the absorption to be exactly 1 degree for every five minutes, and which continues in the same ratio, after the action of the chlorine on the hydro-carbon is over. I have, therefore, always deducted 1 degree for each five minutes, from the total loss, as indicated by the rise of the water in the tube. As, however, the action is over in five minutes, I have seldom continued the trial beyond that time, of course deducting 1 degree from the loss sustained. As chlorine and the condensible matter act on each other in equal volumes, a condensation of 10, when 50 of each are used, indicates ten per cent. of loss by the coal-gas.

Should this method of ascertaining the illuminating power of gases be ultimately found to be correct, another important result may follow its introduction into practice. If we can, by it, fix the illuminating power of one gas compared with that of another gas, the quality of which has been previously determined, and which is consumed with a burner that is known to burn it advantageously, and if the gas which we are subjecting to trial by the shadow test does not show such a high illuminating power as we are led to expect, from the known condensation by chlorine, the probability is, that the burners are not adapted for consuming the gas advantageously, and hence the necessity of altering the apertures, till the power by the shadow is what it ought to be, according to the chlorine test.

There is still another advantage attending the introduction of the chlorine test in addition to those mentioned; it is the facility of comparing different gases with one another, when they cannot be brought together, so as to try them by the shadow. The illuminating power may be considered just as the condensation by chlorine, and thus, then, we may state it *numerically*. Thus taking a coal-gas having only 1 per cent. of matter condensible by chlorine, its illuminating power may be considered as *unity*, and all others would be as *the per centage of condensation*. Hence, also, the illuminating power of gases may be ascertained as compared with other sources of light.

It is evident from what has been said, that, in finding the value of a gas as compared with other sources of light, attention must be paid to the *quality* of the gas; a circumstance which by many has been totally disregarded, and hence the very discordant results which have been obtained. In comparing the gas by the shadow given by other lights, we must in fact not only attend to the different circumstances affecting the combustion; we must also at each trial ascertain the amount of condensation by chlorine; for the quality of a gas manufactured on different days, at the same place will be found to vary considerably. In the trials I am now to state, made with the view of finding the comparative expense of light as got from candles, oil, &c., I have uniformly kept this in view; and by doing so, we are enabled to judge of the expense, not only in this town, but also in other places, provided, of course, we know the illuminating power of the gas by the chlorine test.

The first series of experiments were those with candles, of which ten different kinds were tried. Tallow single wick, tallow double wick, cocoa, palm, composite, margerine, diaphane, composition, spermaceti, wax,—all short sixes.

*Tallow.*—Very different statements have been given of the illuminating power of coal-gas as compared with that from tallow candles, and which has been accounted for by the difficulty of getting the light from the candle to be uniform; the chief cause of the discordance is, however, more probably the difference in the quality of gases manufactured at different places. In conducting my trials, I have paid due attention to the former; trying the candles at different times, so as to have a wick of various lengths. The standard gas light, in all the trials, was a jet burning under a uniform pressure, with a flame of five inches, and consuming exactly one foot per hour.

From numerous trials, I found that the tallow (single wick, short-six), when compared with the gas, and taking the average of all the trials, was as 1 to 3·75. A short-six will be found, when properly snuffed, to last for six hours, or very nearly so; and supposing candles to be 7½ per pound, then the cost for each candle is 5 farthings. Suppose the gas to cost 8s. 4d. per 1000 feet,* then 6 feet will cost 2½ farthings, or very nearly so; accordingly, for half the expense, 3·75 times the amount of light is obtained; in other words, for the same light, the expense of tallow candles is 7½ times that of gas. The gas I employed in these trials contained, on an average, 12 per cent. of condensible matter. Should the gas contain

* I have taken this as being easy for calculation. It is not far from the price of gas in Edinburgh, and in other towns in the neighbourhood of the coal districts.

more or less, then the comparative expense would be greater or less, just according to the quantity. In Edinburgh I have found the chlorine test to indicate from 11 to 14, and 15, very rarely is it up to the latter; of late, I have rarely found it to go beyond 13. Considering the foregoing calculation, as applying to the gas now supplied to Edinburgh, and presuming it to contain 12 per cent. of matter condensible by chlorine, then the expense of tallow candles is 7½ times greater for *the same light*, than that of gas consumed by jet burners.

In England, where the gas is generally manufactured from English caking-coal, the illuminating power is inferior to that of gas got from parrot-coal, or from a mixture of it and common Scotch coal. Now, suppose the price of the gas the same, and that the condensation by chlorine amounts to 6, then the comparative expense of candles and of gas for the same light would be 3·75 to 1.

Similar trials were made with the other candles mentioned.

*Double-wicked tallow*, 1s. per pound.—This candle burns for 5½ hours, at a cost of 8 farthings; the light, compared to that of the jet is as 1 to 2·1, making the expense as 7·1 to 1. This candle has the advantage of not requiring to be snuffed.

*Cocoa* candle, 11d. per pound, will burn for nine hours, at a cost of 7·3 farthings; the light, compared to the jet, is as 1 to 3·6, or the same as that of the common tallow candle; thus, making the expense as 7·3 to 1.

*Palm* candle, 1s. 2d. per pound, will burn for 6·6 hours, expense 9·3 farthings, light 1 to 3, expense as 10·5 to 1.

*Composite*, 1s. 1d. per pound, lasts for eight hours, expense 8·6 farthings, light 1 to 3, expense 8 to 1.

*Diaphane* (French), 1s. 8d., will last 6.6 hours, at a cost of 13·3 farthings, light 1 to 3, expense 15·1 to 1.

*Margerine*, nearly in every respect, the same as diaphane.

*Spermaceti*, 2s. 6d. per pound, will burn for eight hours, cost 20 farthings, light 1 to 2·6, expense as 16·2 to 1.

*Composition* candle the same.

*Wax*, 2s. 6d., burns nine hours, cost 20 farthings, light as 1 to 2·6, expense, therefore, as 14·4 to 1.

Thus the *tallows*, with the exception of the palm, are nearly of the same comparative expense, light for light; the *composition* is a very little more expensive, the others are more than double the expense.

In the foregoing calculations, I have supposed the gas to be consumed by jets; but I have already shown in the paper read before the Society, and published in its Transactions for 1840, that this is the least profitable method of burning it. For *equal consumpts*, the light given by other burners is much greater; thus, taking the jet as 100, that from a fish-tail is 140, from the bat-wing 160, and from a properly constructed argand 180. Accordingly, by consuming the gas with these, the comparative expense will be still farther reduced. The following table gives the comparative light and expense, according to the kind of burner used.

In conducting experiments with the view of ascertaining the illuminating power of oil, compared with that of gas, I used argand oil-lamps of the common construction, and also others with contrivances adapted to them, which have been lately recommended for increasing the light. The first trials were made with *sperm* oil, the cost of which, at the time the trials were made, was 9*s*. 8*d*. per gallon, that is, 1*s*. 2¼*d*. per pint. It was burned in a common argand, consuming the oil under the most favourable circumstances. In endeavouring to fix the illuminating power, I contrasted it with an argand gas burner, having forty-two holes, and consuming 3 feet per hour. I found, however, considerable difficulty in coming to accurate results, partly from the variation in the flame of the oil, partly also from the difference in the appearance of the shadow. Six trials were made at different times, and with the lights at different distances. These varied from 2 to 2·4, taking the oil as 1. The average of the different trials gave 2·35. A pint of oil was found to burn 14 hours, at a cost of 14½*d*.; the consumpt of gas for the same time (3 × 14) was 42 feet, at an expense of 4½*d*., but the light was as 2·25 to 1. The comparative expense, therefore, light for light, would be as 14½*d*. × 2·25 to 4½*d*.; that is, as 8 to 1, or very nearly so.

Rectified *whale* oil was next tried, the cost of which was 4*s*. 8*d*. per gallon. A pint, when consumed under the most favourable circumstances, was found to burn 12 hours; and contrasted with the gas argand as before, the light was as 1 to 2·54. The cost of oil was 7*d*., that of gas for the same time was 3⅓*d*., but the light was as 1 to 2·54; the expense was, therefore, for the same light, as 7*d*. × 2·54 to 3⅓*d*.; that is, 5 to 1.

In the preceding trials the oil was consumed in a common argand, due attention being paid to the different circumstances affecting the consumpt, such as the kind of wick, the height of flame, &c. The next trial was made with the lamp lately introduced under the name of *solar lamp*. In this a cylinder surrounds that containing the wick, with the upper part bent inwards, so that the aperture being contracted, the current of air that passes up between the one

| Candles. Short Sixes. | Burns Hours. | Light compared with Jet. Candle 1. | Cost in Farthings. | | Expense of Candle compared with Jet. | | Light compared with Fish-Tail. | | Expense compared with Fish-Tail. | | Light compared with Argand. | | Expense compared with Argand. | | Comparative Expense of Candles for equal Light. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Candle. | Gas. | Candle. | Gas. | Candle. | Gas. | Candle. | Gas. | Candle. | Gas. | Candle. | Gas. | |
| 1. Tallow. | | | | | | | | | | | | | | | |
| Single wick ........ | 6 | 1 to 3·6 | 5 | 2·4 | 7·5 to | 1 | 1 | 5· | 10·5 | 1 | 1 | 6·48 | 13·5 | 1 | 1·0 |
| 2. Tallow. | | | | | | | | | | | | | | | |
| Double wick......... | 5·5 | 1 .. 2·1 | 8 | 2·2 | 7·1 .. | 1 | 1 | 2·9 | 9·94 | 1 | 1 | 3·76 | 12·78 | 1 | 1·46 |
| 3. Cocoa .............. | 9 | 1 .. 3·6 | 7·33 | 3·6 | 7·33 .. | 1 | 1 | 5· | 10·22 | 1 | 1 | 6·18 | 13·5 | 1 | 1·0 |
| 4. Palm .............. | 6·6 | 1 .. 3 | 9·33 | 2·6 | 10·5 .. | 1 | 1 | 4·2 | 14·70 | 1 | 1 | 5·40 | 18·90 | 1 | 1·32 |
| 5. Composite .......... | 8 | 1 .. 3 | 8·66 | 3·2 | 8·12 .. | 1 | 1 | 4·2 | 11·34 | 1 | 1 | 5·4 | 13·18 | 1 | 1·1 |
| 6. Diaphane .......... | 6·6 | 1 .. 3 | 13·33 | 2·4 | 15·1 .. | 1 | 1 | 4·2 | 21·14 | 1 | 1 | 5·4 | 14·18 | 1 | 2·08 |
| 7. Margerine .......... | 6 | 1 .. 3 | 13·33 | 2·4 | 15·6 .. | 1 | 1 | 4·2 | 22·68 | 1 | 1 | 5·4 | 27·5 | 1 | 2·15 |
| 8. Spermaceti.......... | 8 | 1 .. 2·6 | 20 | 3·2 | 16·2 .. | 1 | 1 | 3·64 | 22.7 | 1 | 1 | 4·86 | 28·44 | 1 | 2·16 |
| 9. Composition ........ | 8 | 1 .. 2·6 | 20 | 3·2 | 16·2 .. | 1 | 1 | 3·64 | 22·7 | 1 | 1 | 4·86 | 29·2 | 1 | 2·16 |
| 10. Wax .............. | 9 | 1 .. 2·6 | 20 | 3·6 | 14·4 .. | 1 | 1 | 3·64 | 20·16 | 1 | 1 | 4·86 | 25·92 | 1 | 1·96 |

In the above calculations, no allowance is made for outlay in gas-fittings, &c., &c.

cylinder and the other, striking against the horizontal part of the outer one, causes a contraction and lengthening of the flame; a longer and narrower glass chimney is at the same time required. The advantages said to attend the use of this construction of burner, are, that an oil of inferior quality may be used, while at the same time the light is greatly increased.

The solar lamp, containing *solar oil*, with a flame as high as could be got to be steady, and without smoke, was contrasted with the gas argand as before, burning three feet per hour. On comparing the lights, and taking the average of numerous trials, conducted at different distances, and when the wick was in different conditions, they were as 0·98 to 1; so very nearly equal that we may consider them as so. The oil, per gallon, costs 3*s.* 8*d.*; a pint was found to burn eight hours, or very nearly so, at a cost of 5½*d.* The gas required for the same time is 24, or say 25 feet, which would cost 2½*d.*; accordingly, the expense is rather more than twice, or say twice, that of the gas.

To ascertain whether or not there is any saving by using the apparatus adapted to the solar lamp, the solar oil was consumed with a solar wick in the same argand with which the trials with the sperm and whale oils were made, and the light, as before, was contrasted with the argand, burning three feet per hour. The light and the consumpt of oil were found to be the same as with the other oils. The cost of the solar oil per pint is 5½*d.*, that of the whale oil 7*d.*; accordingly the expense is as the cost of the oils. It has been already stated, that by using the solar apparatus, the oil gave a light equal to that from an argand consuming three feet per hour, and that the pint of oil will last for eight hours; the expense is therefore as 2½*d.* to 5½*d.*, or say 1*d.* to 2*d.* Now when the solar oil was burned in the common argand, and contrasted with the gas argand, the light was as 1 to 2·54. As the oil lasted for twelve hours, the cost of gas for that time would be 3½*d.*, or very nearly so. The comparative expense was therefore as 5½*d.* × 2·54 to 3½*d.*; that is, as 3·98 to 1; whereas, by the solar lamp, it was only as 2 to 1; thus making a saving by the use of the solar lamp of nearly one-half of the expense. This peculiar construction of lamp is therefore a very great improvement; for not only is there a saving in expense in the outlay for oil, but for the lighting of large apartments a smaller number of lamps is required than when common argands are employed.

*Naphtha.*— This article has been lately recommended as an economical source of light. Though naphtha gives a beautiful and steady light, yet it emits an offensive smell, and unless cautiously burned, is very liable to smoke; the slightest blast against the flame causing dense black smoke instantly to appear. The appearance of the shadow is so different from that from coal-gas, that it is not easy to fix their illuminating power and consequent comparative expense. In the experiments I have performed, I used the gas-argand as before, consuming 4 feet per hour. The naphtha-lamp had a wick of 4 inches in breadth, and burned with a flame of about half an inch in height. In one trial I made the illuminating power of the flames, as naphtha 1 to gas 4·233; in another, they were as 1 to 4·239;—giving an average of 1 to 4·236. The consumpt of naphtha was a pint in 24 hours, at a cost of 3*s.* 6*d.* per gallon, that is 5¼*d.* per pint. The gas for the same time would be 24, or say 25 × 4 = 100—that is 10*d.*; but the light was as 4·236 to 1—therefore the comparative expense comes to be as 2·2 to 1, or very nearly so. Suppose that I have overrated the illuminating power of the gas as compared with that of the naphtha, say, that instead of 4·236, it was about 4, this would reduce the cost of the latter, and thus make the comparative expense as about 2 to 1.

*Table showing the Consumption and Expense of Oils, and of Gas, in Argands, burning three feet per hour.*

| Oils per Pint. | Pint burns Hours. | Light of gas compared with oils as 1. | Cost in farthings of | | Comparative Expense for equal lights. | | Comparative Expense of Oils for equal Lights. |
|---|---|---|---|---|---|---|---|
| | | | Gas. | Oil. | Gas. | Oil. | |
| Sperm in Argand...... | 14 | 2·35 | 17 | 58 | 1 | 8 | 4 |
| Whale ditto ...... | 12 | 2·54 | 14 | 28 | 1 | 5 | 2·5 |
| Solar ditto ...... | 12 | 2·54 | 14 | 22 | 1 | 3·98 | 1·99 |
| Solar in Solar lamp.... | 8 | 1 | 10 | 22 | 1 | 2 | 1 |
| Naphtha lamp ........ | 24 | 3·17 | 40 | 21 | 1 | 2 | 1 |

*Table showing Comparative Expense of Light from different Sources; Coal-Gas containing 12 per cent. of matter condensible by Chlorine, taken as unity.*

| | | | | | |
|---|---|---|---|---|---|
| Argand Gas | 1·00 | | | | |
| Fish Tail | 1·40 | Fish Tail | 1·00 | | |
| Single Jet | 1·80 | .. | 1·40 | Jet | 1·00 |
| Solar Lamp | 2·00 | .. | 1·55 | .. | 1·11 |
| Naphtha | 2·00 | .. | 1·55 | .. | 1·11 |
| Solar Oil in common Argand | 3·98 | .. | 2·84 | .. | 2·21 |
| Whale Oil ditto | 5·00 | .. | 3·88 | .. | 2·77 |
| Sperm ditto | 8·00 | .. | 6·22 | .. | 4·41 |
| Tallow Candle (two wicks) | 12·7 | .. | 10·0 | .. | 7·18 |
| Cocoa Candle | 13·1 | .. | 10·2 | .. | 7·33 |
| Tallow ditto (one wick) | 13·5 | .. | 10·5 | .. | 7·50 |
| Composite | 14·5 | .. | 11·3 | .. | 8·12 |
| Palm | 18·9 | .. | 14·7 | .. | 10·5 |
| Wax | 25·9 | .. | 20·1 | .. | 14·4 |
| Diaphane | 27·1 | .. | 21·1 | .. | 15·1 |
| Margerine | 28·4 | .. | 22·6 | .. | 15·6 |
| Spermaceti | 29·2 | .. | 22·7 | .. | 16·2 |
| Composition | 29·2 | .. | 22·7 | .. | 16·2 |

## MR. BADDELEY'S IMPROVEMENT IN FIRE-ENGINES.—[SEE PAGE 364.]

Sir,—An "Old Subscriber," in your last Number (page 474), questions the propriety or advantage of an improvement which I recently suggested to be made in fire-engines, in order to remedy the inconvenient effects of *vis inertiæ*.

Your correspondent seems to deny that the inconveniences complained of are due to *vis inertiæ*, and states that, "the evil generally originates from the unsound state of the cock, feed or suction pipe, particularly when more than one length is on, which admits a portion of air through the seams, joints, &c.; yet not sufficient to prevent the engine fetching, or charging itself at first."

To this view of the case I reply that the engines referred to have *no suction-cock:* this piece of apparatus being dispensed with from its great liability to derangement; and moreover, that the phenomenon I have described, occurs when a single length of suction hose is employed, and that a perfectly sound one.* Supposing, however, that the evil really originated in the way your correspondent states, from the engine having no suction cock, *his remedy* could not be applied, and therefore my suggested improvement would come in very à-propos. The case, however, is really otherwise, as your correspondent has evidently yet to learn. That an effect somewhat similar, though not in reality identical, takes place in working old and dilapidated engines,† as stated by "An Old Subscriber," I am well aware, and I beg to point out to him that the *addition to the engine*, which he affects to despise, is by far the *best and easiest* remedy he could resort to.

This present practice of pumping the engine-cistern half full of water, *previous to discharging any on the fire*,—that is, at the commencement of a fire, when every minute is invaluable,—is a wretched misappropriation of time and labour when minutes are of far greater importance than hours would be at a later period. Let us suppose that his engine is fitted with a cock, as I have suggested, only opening into, instead of beneath the cistern. The engine is brought to a fire, and is set to work upon it direct; after a while the engine stops, the air enters the barrels, but the cock having been opened, the water is discharged from the elevated hose into the cistern of the engine. When it is again required to "go on," the engine "fetches" as at first; but should it from some cause or other fail to do so, the "practical fireman" can then resort to his remedy by manœuvring the suction-cock, and so effect his object without the previous loss of time or water.

From this view of the matter it follows, that whether the stoppage arises from the *vis inertiæ*, or the unsound state of the machinery, the remedy I have suggested is equally applicable in either case.

I remain, Sir,

Yours respectfully,

WM. BADDELEY.

29, Alfred-street, Islington.
November 19, 1842.

* The suction pipes, as well as the delivery hose of the best description, are now all riveted, and therefore cannot leak at the seams.

† The evil in this case occurs without the hose being in an elevated position, and therefore is certainly not attributable to the *vis inertiæ* of the water column.

### THE CLEANSING OF WATER PIPES.

Sir,—Your correspondent "J. Cole," seems rather inclined to be facetious concerning a certain point in my last, while at the same time he exultingly points his antagonist, Mr. Baddeley, to a fact which favours his own side of the question. I would venture, however, to suggest to Mr. C., that he or Mr. Stuckey can supply the dealers to whom he alludes with an excuse, which certainly would not break down so soon as that, which he is so benevolent as to discover for them in my communication. "*Our tea, Madam, cannot be done justice to unless the water has been filtered according to Mr. Stuckey's plan. The absence of carbonic acid-gas causes a bad flavour to appear prominent, and till you can obtain Stuckey's water you will not have good tea.*" This would serve "Mr. S." by enlisting a very important body on his side, viz. *the old maids.*

However, to be serious: I know the details of Mr. Stuckey's process; it may be good, it may be absolutely perfect; but I merely point out that even if the water left the reservoir in a pure state it would not reach the consumer in equal perfection, because in many cases it would pass through a great length of dirty and corroded pipes.

It is the besetting failure of inventors, that they cannot judge impartially. Their own invention is in their eyes the *perfect one* to the disparagement of every other. Mr. Stuckey has, I think, fallen into this error by condemning all small filters. There is one construction of small filter, which *does not destroy* the carbonic acid to the extent spoken of by Mr. S. if it does at all. I believe that using charcoal as one of the filtering mediums obviates the defect which he speaks of.

However, I hope that Mr. S. does not mean to say, that because a substance or fluid may become putrid by lapse of time, it therefore is injurious to eat that substance or drink that fluid, before it putrefies; or else his objection would apply to beef, or mutton, &c.

With most sincere good wishes for the success of Mr. Stuckey or any one else, who may be the means of supplying the public with better water,

I remain, yours truly,

W. H.

St. John-street-road.

### THE MECHANICS' ALMANACK, AND ENGINEERS' YEAR-BOOK, FOR 1843.

The last year's number of this popular and useful almanack, was full to overflowing with articles on the bread and cheese questions which then occupied, and still unfortunately occupy, so much of the public mind—the Corn Laws—the Sugar Duties—the Rate of Wages, &c.; the present is more largely devoted to matters of a mechanical and engineering description, and will not, on that account, we apprehend, be less acceptable, or less useful to the generality of our readers. We have first, a well-classified list of all the Patents for new inventions granted during the past year, with a good digest of the New Designs Registration Act, and instructions for registering. Two interesting articles follow, on (Mr. Smith of Deanston's) improvements in the construction of factories, and on the internal regulation of the same, so far as regards payment of wages—use of stimulants at work—dress of workmen, &c. The substance of the late parliamentary report on the state of labour in our coal and other mines is then given, with an abstract of Lord Ashley's excellent Act, for the abolition of female and infant labour. A number of valuable scientific tables next present themselves, among which we must notice with particular approbation a Table of the comparative strength and other properties of British irons, a Table of approved proportions of stationary steam-engines, a Table of the velocities of steam-engines, (compiled from a larger Table of the late lamented Samuel Seaward, Esq.), and a Table of the proportions which the journals of first movers should bear to engine-power and speed. The Admiralty regulations respecting the examination, appointments, &c. of engineers in the Royal Steam Navy are given at length, and a very complete statement of the number and tonnage of British shipping, including steamers as well as sailing vessels. From the miscellaneous articles, which are of a more quotable description than the rest, we select the following article on the Elements, as an example of the new and useful sort of information which the work contains.

### THE ELEMENTS.

"Anciently it was thought there were but four elements or simple bodies, namely, earth, fire, air, and water; the alchemists reduced these to three—salt, sulphur, and mercury, to which Paracelsus added two more, which he called *phlegm* and *caput mortuum* (the water and earth of the more ancient philosophers). Modern chemistry has completely overthrown the whole of these theories, and shown us not only that all the elementary bodies of the olden time are mere compounds, but that instead of four, or three, or five, the number of simple bodies is at least fifty-four. By simple bodies, however, the reader must understand only bodies which chemical analysis has not

yet been able farther to divide or decompose; for it does not necessarily follow, because they have not been as yet decomposed, that they are actually undecomposable. The following is a list of these simple substances at the present time :—

| | |
|---|---|
| Oxygen | Bismuth |
| Hydrogen | Cadmium |
| Nitrogen | Cermium |
| Chlorine | Chromium |
| Iodine | Cobalt |
| Bromine | Columbium |
| Fluorine | Copper |
| Sulphur | Gold |
| Phosphorus | Iridium |
| Selenium | Iron |
| Carbon | Lead |
| Boron | Manganese |
| Silicium | Mercury |
| Potassium | Molybdenum |
| Sodium | Nickel |
| Lithium | Osmium |
| Aluminum | Palladium |
| Calcium | Platinum |
| Magnesium | Rhodium |
| Barium | Silver |
| Strontium | Tellurium |
| Glucinum | Tin |
| Zirconium | Titanium |
| Thorium | Tungsten |
| Yttrium | Vanadium |
| Antimony | Uranium |
| Arsenic | Zink |

"Although the simple or undecomposed bodies are so numerous, the great bulk of the vegetable world is composed but of three —oxygen, hydrogen, and carbon, and the animal world of the same three, with the addition of nitrogen. It has been further calculated, that one half the habitable world is made up of oxygen alone, for besides the important part which it plays in the vegetable and animal kingdoms, it forms half of all the water of the globe, about one fourth of its atmosphere, and enters more or less into the composition of every earth and stone."

## THE SMOKE NUISANCE AS IT WAS AND IS.

We extract the following very pertinent observations on this subject from Mr. J. Harrison Curtis's recently published work, "The Preservation of Health."

"That an abundant supply of pure air is indispensable to the enjoyment of health, and it is a truth universally admitted in words, but, like many other truths, this is wofully disregarded in practice. To how large a proportion of the inhabitants of London, for instance, is this necessary of life denied! Hemmed in closely on all sides by brick walls, they scarcely ever feel the breeze blowing freely on their cheeks; and the atmosphere is impregnated with, and vitiated by, a thousand different exhalations and fumes, which render it more capable of still further corrupting the blood than of conducing to its purification. It is nearly 200 years ago since a similar complaint was made by the well-known John Evelyn, at a time when the evil cannot have been at all comparable in magnitude to what it now is.

Speaking of the situation of London, he says :—"We shall every way finde it to have been consulted with all imaginable advantages, not onely in relation to profit, but to health and pleasure; and that if there be any thing which seems to impeach the two last transcendencies, it will be found to be but something extrinsecal and accidental onely, which naturally does not concern the place at all, but which may very easily be reformed, without any the least inconvenience."

And again, a little farther on: "But I will infer, that if this goodly city justly challenges what is her due, and merits all that can be said to reinforce her praises and give her title, she is to be relieved from that which renders her less healthy, really offends her, and which darkens and eclipses all her other attributes. And what is all this but that hellish and dismal cloud of *sea-coal*, which is not only perpetually imminent over her head, but so universally mixed with the otherwise wholesome and excellent air, that her inhabitants breathe nothing but an impure and thick mist, accompanied with a fuliginous and filthy vapour, which renders them obnoxious to a thousand inconveniencies, corrupting the lungs, and disordering the entire habits of their bodies; so that catarrhs, phthisicks, coughs, and consumptions, rage more in this one city than in the whole earth beside."

In confirmation of this last assertion, he afterwards asks, "Is there under heaven such coughing and snuffing to be heard as in London churches, and assemblies of people, where the barking and spitting is incessant and most importunate?"

He gives the following corroboration of his opinion as to the deleterious effects of the "sea-coal" smoke upon the air of the metropolis :—"Not to be forgotten is that which was by many observed, that in the year when Newcastle was besieged and blocked up in our late wars" (the civil war between Charles the First and the Parliament), "so as through the great dearth and scarcity of coales, those famous works, (*i. e.* factories, &c. &c.), many of them were either left off, or spent but few coales in comparison to what they now use; divers gardens and orchards, planted even in the very heart

of London (as, in particular, my Lord Marquesse of Hertford's, in the Strand, my Lord Bridgewater's, and some others about Barbican), were observed to bear such plentiful and infinite quantities of fruit, as they never produced the like either before or since, to their great astonishment; but it was by the owners rightly imputed to the penury of coales, and the little smoake which they took notice to infest them that year. For there is a virtue in the air to penetrate, alter, nourish, yea, and to multiply, plants and fruits, without which no vegetable could possibly thrive."*

"As a remedy for these evils, he proposes a legislative measure for compelling the removal of all such establishments to some distance from town. It is much to be regretted that this proposal was neglected; for the evil has so grown upon us, that its remedy seems almost impossible, at least by the measure which he suggested. The advance of science, however, has put other and more simple means within our power for removing or abating the nuisance in question; all that is necessary, is an act compelling all factories, breweries, gas-works, *et hoc genus omne*, to consume the smoke which they generate, and not to pollute the vital element with their refuse.

"This measure I conceive to be of the utmost importance, and essential to the success of any other plans for improving the public health. Parks, and other places of public resort and amusement, derive the chief part of their utility from furnishing opportunities and inducements for exercise in the open air; but if that air be tainted and rendered unwholesome, this becomes an evil rather than a good.

"The means to which I allude as enabling us to get rid of the nuisance in question, is the patent smokeless or argand furnace of Charles Wye Williams, Esq., which is an invention of considerable importance. Mr. Williams is author of an elaborate treatise on the 'Combustion of Coal and Prevention of Smoke, chemically and practically considered;' in which he gives an excellent exposition of the chemical theory of combustion, and ascertains the mechanical arrangements that are best calculated to burn with the greatest effect on the grate-bars the carbonaceous fuel and its gaseous products. To the improper and imperfect combustion of the latter are to be attributed those thick fuliginous particles which, in the form of smoke, contaminate our atmosphere. Mr. Williams's agents, Messrs. Dircks and Co., of Manchester, have built a specimen furnace in that town for public inspection, and they have informed me that it has been visited by several of the nobility, as well as by the most intelligent engineers and manufacturers in that district. The novelty of this invention is, that the coals are burnt on the large scale of common engine-boiler furnaces without producing smoke; so that, as has been stated, there is literally no smoke to burn; and, indeed, Mr. Williams in his work ably and most scientifically combats the opinion that 'smoke' can be *burnt*, that is, with heat-giving effect; and on this he grounds the want of success that has attended 'smoke-burning' inventions generally for the last 25 years. Mr. Williams's may be called a system of prevention, and depends on a chemical knowledge of the due quantity of air requisite for combustion, and the best mode of regulating its admission. This plan is in use in many large establishments and public works, especially in Manchester and Liverpool, and has met with the approbation of several of the most distinguished chemists and civil engineers—among others, of Professor Brande, Dr. Ure, Dr. Kane, Dr. Brett, Mr. Parkes, &c. &c."

* "Fumifugium; or, the Inconveniencie of the Aer and Smoak of London dissipated: together with some Remedies humbly proposed to his Sacred Majestie and to the Parliament now assembled. London, 1661."

## ABSTRACTS OF SPECIFICATIONS OF ENGLISH PATENTS RECENTLY ENROLLED.

F. P. WALKER, OF MANCHESTER, COAL MERCHANT, *for certain improvements in the manufacture of candles, candlesticks, or candle-holders, and in the apparatus connected therewith.* Patent granted, May 9, 1842.

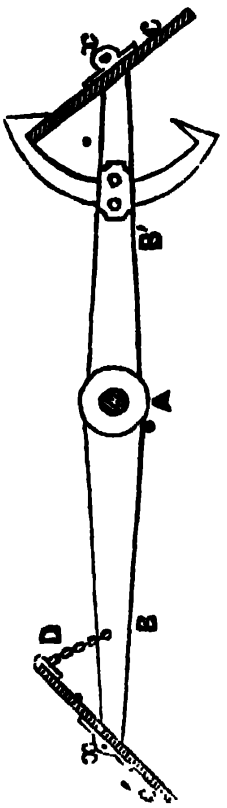
The first of these improvements consists in making candles, either of an oval or circular shape, with three or more wicks, so that, when lighted, the flame shall have the appearance of what is commonly called the "bat's-wing;" and be also much brighter, and more intense, than the light furnished by separate candles.

A second improvement consists in making the candlestick round on the inside, but of an oval form inside.

A third improvement consists in making the candle-holder large enough to receive a candle of any size ordinarily made, but inserting in the tube a vertical rod, with a screw at the top and a semicircular piece of brass at the bottom, with a screw behind, so that, by turning the screw, the semicircular piece of brass shall press the candle against the side of the tube, and thereby render the candle steady.

JOHN MELVILLE, OF UPPER HARLEY-STREET, ESQUIRE, *for certain improvements in propelling vessels.* Patent granted, May 9, 1842.

The first of these improvements is represented in the following diagram.



A is the shaft or axle; B $B^1$, the arms of the wheel, to the extremities of which are fixed two propellers, or boards, C C, suspended on swivel centres at *x x*. The lower ends of the propellers or boards C $C^1$ are weighted, so as to cause them to assume, when in the water, a vertical position. At one extremity of the arm B is shown one mode of determining the angle at which the propeller C should rise from the water, and at the end of the other arm $B^1$ is represented the method of regulating the action of the propeller C. The propeller C is attached to a chain adjusted to a suitable length, so as to cause the propeller to rise from the water at the angle of 90°, and not to reciprocate, or swing about. The other mode is similar in principle, only that an iron arc of a circle, with hooked extremities, is made use of, instead of the chain, to keep the propeller at an angle of 90° when leaving the water.

A second improvement consists in employing a fixed propeller-shaft or axle, with revolving arms, which can be shipped or unshipped at pleasure.

The third and last improvement consists of a lever fixed to the side of the vessel, having at one end a paddle revolving on its axis, and which can be easily stowed away when the vessel has a fair wind.

The claim is, 1. To paddles or floats regulated by the chain or arc.

2. To the fixed propeller-shaft, or axe, with movable arms.

3. To the side lever, with paddle attached.

JOHN BENNETT LAWES, OF ROTHAMSTED, IN THE COUNTY OF HERTFORD, ESQUIRE, *for certain improvements in manures.* May 23, 1842.

Bones, bone-ash, bone-dust, and other phosphoritic substances have been before now employed as manures, but always in a chemically undecomposed state, whereby their action on the soils to which they have been applied has been tardy and imperfect. It is well known, for example, that, in the case of a large proportion of the soils of this country, the application of bone-dust is of no utility in producing crops of turnips, on account of the slow decomposition of the bone-dust in the soil, and the consequent exposure of the young plant, for a long period, to the ravages of the turnip-fly. The present improvements are founded on an intelligent observation of these facts, and appear to be of more than ordinary importance to the agricultural interest. Generally, they may be described as consisting in decomposing the bones, bone-ash, bone-dust, and other phosphoritic substances, *previous* to using them for the purposes of manure, by the following process. The inventor mixes with the bones, bone-ash, or bone-dust, or with apatite, or phosphorite, or any other substance containing phosphoric acid, a quantity of sulphuric acid, just sufficient to set free as much phosphoric acid as will hold in solution the undecomposed phosphate of lime, whereby the free phosphoric acid is enabled to unite itself at once with the various alkaline earths contained in the soil, and the undecomposed phosphate of lime is left in a state of division, far greater than can be effected by any mechanical means. In the case of soils deficient in any particular alkali, as potass, or soda, or magnesia, or ammonia, the patentee recommends the use of a manure compounded of a mixture of phosphoric acid with the particular alkali required, as potass, or soda, or magnesia, or ammonia, or any earth containing such alkali.

The same improvements, or at least improvements very like them, were recently patented by Sir James Murray, in Scotland, but *subsequently* to the present patent for England, having been obtained by Mr. Lawes. So far as England is concerned, Mr. Lawes is the only true inventor and patentee.]

## LIST OF ENGLISH PATENTS GRANTED BETWEEN THE 2ND OF SEPTEMBER, 1842, AND THE 17TH OF NOVEMBER, 1842.

Matthew Gregson, of Toxteth Park, Liverpool, esquire, for improvements applicable to the sawing or cutting of veneers. (Being a communication.) November 2; six months.

Joseph Edwards, of Bloomsbury Square, clerk, for an improved razor-strop, or instrument for sharpening certain cutting edges, and an improved material for covering the same, which material is also applicable to other purposes. November 2; six months.

Sir John Scott Lillie, of Chelsea, for certain improvements in roads. November 2; six months.

Pierre Pelletau, of Bedford Square, esquire, for improvements in the production of light. November 2; six months.

James Bullough of Blackburn, overlooker, for certain improvements in the construction of looms, for weaving. (Being a communication.) November 3.

Richard Bevan, of Liverpool, wine merchant, for certain arrangements connected with the circulation of steam employed in pipes or tubes for producing heat, and the application of such arrangements to various purposes. November 5; six months.

John Rothwell, of Great Bolton, grocer, for a certain composition and preparation to promote the ignition and combustion of coke, coal, and other combustible substances, in stoves, furnaces, and grates. November 5; six months.

William Coley Jones, of Vauxhall-walk, Lambeth, practical chemist, for improvements in treating or operating upon a certain unctuous substance, in order to obtain products therefrom for the manufacture of candles, and other purposes. November 8; six months.

Pierre Frederick Ingold, of Buckingham-place, Hanover-square, watchmaker, for improvements in machinery for making parts of watches and other time-keepers. November 8; six months.

Arthur Harvie, of Wilmington-square, gentleman, for improvements in the process of vinous fermentation. (Being a communication.) November 8; six months.

Thomas Wrigley, of Bridge Hall, Bury, Lancaster, paper manufacturer, for certain improvements in machinery for manufacturing paper. November 8; six months.

John Mitchell, of Birmingham, steel pen manufacturer, for a certain improvement in the manufacture of metallic pens, and a certain improvement in the manufacture of pen-holders. November 8; six months.

John Spinks, the younger, of John-street, Bedford-row, gentleman, for an improved apparatus for giving elasticity to certain parts of railway and other carriages requiring the same. November 8; six months.

Henrik Zander, of North-street, Sloane-street, engineer, for certain improvements in steam-engine boilers and furnaces, and in the methods of feeding and working the same; as also in the machinery for applying steam power to propelling purposes. November 8; six months.

John Barnes, of Church, Lancashire, manufacturing chemist, and John Mercer, of Oakenshaw, Lancashire, calico printer, for certain improvements in the manufacture of articles, used in printing and dyeing cotton, silk, woollen, and other fabrics. November 10; six months.

Charles Rowley and James Turner, of Birmingham, button manufacturers, for improvements in the manufacture of perforated metal buttons. November 15; six months.

André Eustache Gratien Auguste Maurras, of Cornhill, gentleman, for certain improvements in the process and apparatus for filtering water and other liquids. (Being partly a communication.) November 15.

Charles Smith, of Newcastle-street, Strand, for improvements in the manufacture and application of bricks, tiles, and other plastic articles or surfaces, and for cements or compositions to be used with, in, and about the same, for building and other useful purposes. November 17; six months.

## NOTES AND NOTICES.

*State of Mining Machinery in Spain.*—Improvements of all kinds find their way very slowly into Spain, especially into remote mountain districts, devoid of roads and infested with bands of robbers. The labour of unwatering the mines of Almaden is in particular severe and expensive. A grand reservoir has been formed in the rock in the fifth level, and into this the water of the lower levels is elevated by hand-pumps, at an expense of manual labour of 200,000 reals per annum, although the elevation of this general receptacle above the greatest depth is only 110 varas. It is then pumped to the surface by a single-stroke steam-engine, the annual cost of which performance is reckoned at 60,000 reals (600*l.* sterling). This engine is a perfect curiosity, constructed on the principle, or rather in imitation of, Watt's first engine, with various subsequent additions, which are the very reverse of improvements, and which, by some miracle, found its way to Almaden in the year 1799, having been probably rejected thirty years before in England. It is an immense lumbering counterpoise affair, with a long cooling-pipe between the boiler and the cylinder, and no valve between, so that the principle of expansion cannot be applied. The condenser sends forth the water nearly boiling-hot, which is no wonder, seeing that its valve has no governor and no connexion with the moving machinery. In consequence, the boiler takes exactly double the fuel requisite to raise the quantity of water from the mine that it ought to do, and the engine, calculated to be of 42-horse power, only does the work of 20½. Besides these motive powers, steam and manual, there is an establishment of from thirty-five to forty excellent mules, which are kept constantly at work, eight at once, in drawing up the ore by a very rude wheel capstan, the friction of which is so great that the animals can only work three hours in the twenty-four, and, although selected expressly for the labour, at a high price, several are disabled in the course of the season. There is no water-power available to move machinery in these mines, and there has been very little care bestowed to render any of the mechanical powers available for the abridgement of labour. Even the ore, which is brought up from the deep sinkings by mules at the rate of 3500 arrobas (25 lbs. each) per day of twelve hours, is all drawn to the furnaces by oxen in rude carros, without the slightest aid from a railway.—*Correspondent of the Times.*

*Stupendous Aqueduct at New York*—The ceremony of introducing the Croton waters into New York lately took place, and was concluded amidst great rejoicings. By syphons, aqueducts, &c., the Croton is conducted a distance of forty-five miles into New York, the whole expense having been 9,000,000 dollars. The enormous quantity of 75,000,000 of gallons per day, or three hogsheads for every inhabitant, will thus be conveyed to the city, at an annual charge of 600,000 dollars; while London is supplied with only 34,000,000 of gallons, or seventeen gallons per inhabitant, for 1,380,000 dollars; and Paris, 4,000,000 gallons, or two quarts per individual, for 750,000 dollars.



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Mechanics' Magazine,
MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1008.] SATURDAY, DECEMBER 3, 1842. [Price 3d.

Edited, Printed and Published by J. C. Robertson, No 166, Fleet-street.

## ROLL'S DOUBLE REVOLUTION HIGH-PRESSURE ENGINE.

Fig. 1.

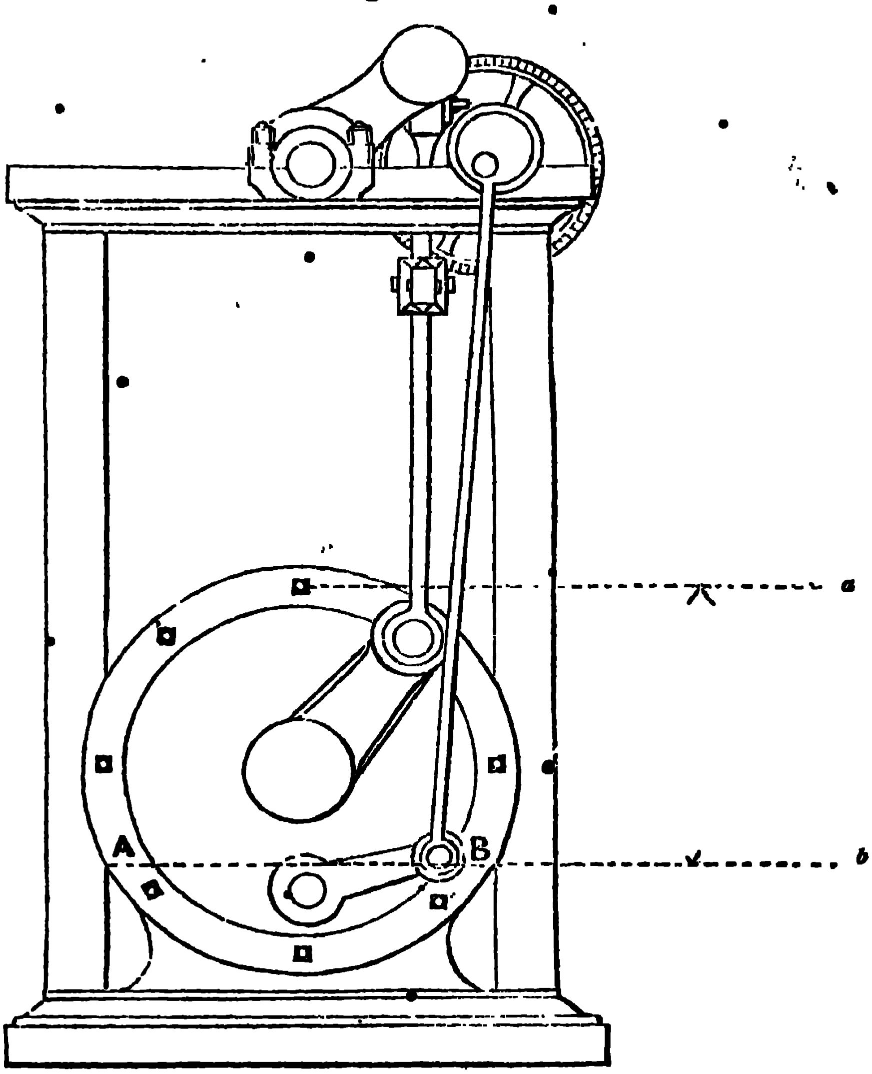
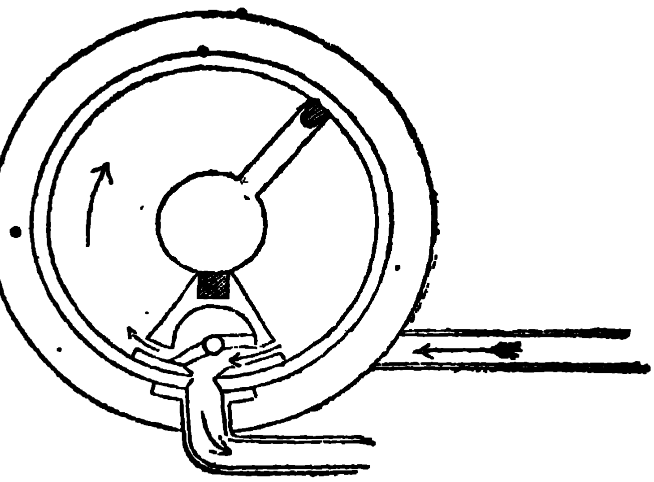



Fig. 2.



Sir,—I beg to send you a sketch of an engine of my invention, which I consider to be perfectly new, and to possess some obvious advantages over those in ordinary use. Should you favour it with a place in your valuable Magazine, you will much oblige,

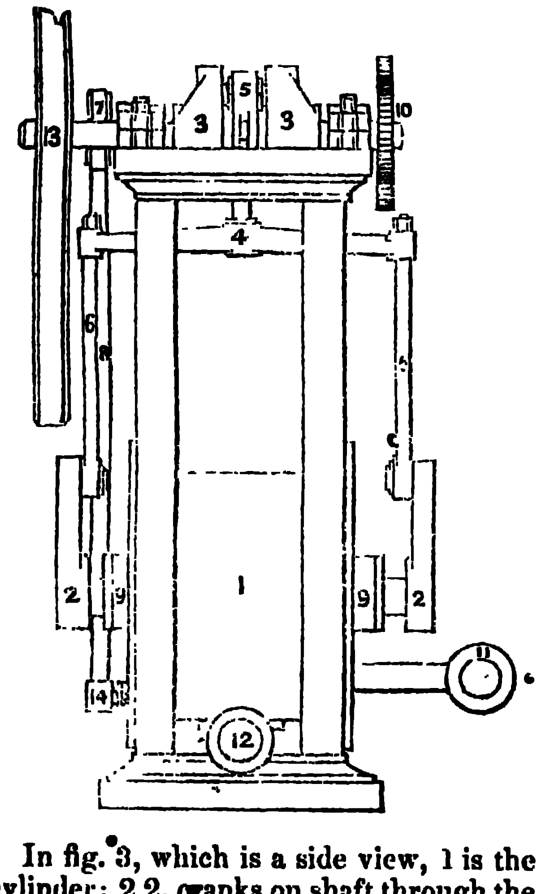
Your obedient servant,
THOMAS ROLLS.

123, Albany-road, Old Kent-road, London.
October 20, 1842.

*Description of the Figures.*

Fig. 1 is a front view of the engine.
Fig. 2, a section of the cylinder.

Fig. 3.




In fig. 3, which is a side view, 1 is the cylinder; 2 2, cranks on shaft through the cylinder; 3 3, main crank; 4, cross head, with connecting-rods to cranks 2 2; 5, strap head, connected with cross head, 4; 6 6, the connecting-rods of 4 and 2 2; 7, the eccentric, worked by cog-wheels, 10, in the proportion of 12 to 24, the smaller one being on the main shaft, the larger on the eccentric spindle, so that the shaft makes two revolutions for the eccentric's one; 8, rod from the eccentric, to work the cylindrical slide-valve, 14; 9 9 9, stuffing-boxes; 10, the two cog-wheels, in the proportion of 12 to 24; 11, steam-pipe from boiler; 12, waste-pipe; 14, cylindrical slide-valve.

The length of stroke is indicated by the dotted lines. *a b* in fig. 1. As the crank traverses from A to B, the steam crank performs one revolution, and from B to another; and on account of this, which is the distinguishing feature of the engine, I call it the "Double Revolution High-pressure Steam-engine."

T. R.

MR. LUCY'S SUBSTITUTE FOR THE FLY-WHEEL.

Sir,—Those who uphold the doctrine of a loss of power by the action of the crank, the fly-wheel, or any other machine, may, with due consistency, consider Mr. Lucy's apparatus as "an improvement of greater consequence than any which has been made in the crank-engine for many years." Your correspondent, "A Looker-on," does not, indeed, openly avow himself to be of this opinion; but it appears plainly from his letter, at page 438, that the only way he is inclined to account for the alleged gain of power by the iso-dynameter is, by the old story of the loss from the action of the fly-wheel.

Without meaning any disrespect to your correspondent, I must beg to decline entering into any controversy on this subject. The doctrine, that machines (considered apart from the external circumstances of friction and resistance of the air) can only *transmit* power, and are utterly incapable of causing either *gain* or *loss* in the transmission, has been demonstrated over and over again, in such a variety of ways, both from theoretical and practical considerations, that I am sure, if doubters will not be convinced by what they may find in almost any mechanical treatise, it would be a useless and reprehensible occupation of your pages to reproduce these often-used arguments. I will merely quote the following passage from Mr. Scott Russell's Treatise, already mentioned:—"The great fundamental principle in the construction of machinery is, that the work done depends in quantity only upon the quantity and velocity of the power applied, and not at all upon the form of the machine;

in other words, *that a machine has no power, either of consuming or creating motive power*—that it can only transmit it." If this is not so, then most certainly "all the experience of the laws of matter, which has been obtained since the use of inductive philosophy, is false," and "our whole system of mechanics, since the time of Galileo, has been resting on a fallacy." Let the contrary of this be proved, and the immortal discoverer of the three laws of motion is proved to have been a teacher of sophistry and a propagator of error.

I am not alone in the strictures I have been compelled to make on Mr. Parkes's too frequent habit of setting up his own unsupported opinion as authority not to be questioned, often in direct opposition to those who ought to be better judges than himself. You, yourself, Mr. Editor, have had occasion to notice a case exactly in point, namely, the report on the "Boccius Light," where (page 299) you justly complain, that "the learned reporters nowhere assign any *sufficient reason* for the superiority which they are pleased to assign" to the invention they are puffing. This is exactly what I complain of, and, by changing a few words, I might have adopted your very language throughout the paragraph. He *ought* to assign a "sufficient reason" why the substitution of the iso-dynameter causes a gain of power; but instead of this, "*how* the gain is effected, the reader is left to find out for himself."

But your correspondent cannot understand why I should doubt Mr. Parkes's inference: I thought I had given my reasons, but I suppose I must have stated them unintelligibly; I will repeat them in a more syllogistic form.

Supposing that, from some cause or other, the engine does more work now than formerly:

1. If this is caused by the substitution of the new regulator for the old, it must arise from one of three sources, which I named.

2. It does not arise from the first or second, because no machine can cause either gain or loss of power.

It does not arise from the third, as admitted by "A Looker-on."

Therefore, it does not arise from either of the three; and,

3. Therefore, the gain is *not* caused by the substitution of Mr. Lucy's machine for the fly-wheel. Q. E. D.

The increased efficiency of the engine may arise from many other causes than that assigned; and, in the absence of better proof than has hitherto been given, that it does arise from the iso-dynameter, we may at least be permitted the privilege of doubting.

The side-thrust at mathematical reasoning comes, as a matter of course, from all the "loss of power" people. It is but natural that those whose doctrines reason condemns should wish to prevent us from reasoning at all, and leave us at the mercy of every mechanical *Sir Oracle*, whose dogmas will not bear the test of examination.

I am, Sir,
Your obedient servant,
π.

November 21, 1842.

MACERONE'S WATER-PROOF BOOTS—OIL FOR ASTRONOMICAL INSTRUMENTS, AND LEATHERN HOSE.

Sir,—The setting in of the "rainy season" will lead the prudent to "look to their boots and shoes," and by the timely application of Col. Macerone's inestimable "water-proof," preserve to themselves the superlative comfort of "dry feet."

The several patentees of wood paving ought to unite in presenting the gallant Colonel with some slight recompense for the pains he took in paving the way for their systems. However, neither the importance of his advocacy in this matter, nor his other numerous, if not more important inventions, seem so likely to immortalize his name, as his "water-proof composition,"* for the *under*-standings of the human race; a knowledge of the utility of which, I was happy to find, was not confined to our own country alone, but was known and duly appreciated on the Continent.

While I was recently in Hamburg, I heard Colonel Macerone's composition spoken of in the most complimentary manner, and Mr. Campbell, (the agent there for the *Mechanics' Magazine*,) informed me that he had adopted a novel method of application, which had been attended with considerable advantage. Instead of brushing the composition over

* Simply two parts of tallow and one part rosin, melted together and applied warm.

the *external* surface of the boot, he had applied it *internally*. The boot being thoroughly warmed before the fire, the melted composition was poured in, and after turning the boot about, so as to apply the composition to every part of it, the superfluous quantity was poured out. The boot was then kept warm until the composition had been wholly absorbed by the interior surface of the leather. On wearing the boots so treated, the first pair of stockings was soiled slightly; the second, not at all; while the boots were rendered wholly impervious to wet, carried the most brilliant polish that "Day and Martin" could bestow, and were entirely free from that unpleasant sensation of *coldness* which is always experienced from boots to which the composition has been applied externally.

Mr. Campbell further informed me, that he had obtained a most excellent lubricating material for sextants, and other delicate astronomical instruments in brass, by mixing a small quantity of rosin with the best olive oil: in the proportion of one ounce of rosin to a pint of oil melted together. The oil thus treated never turns rancid, nor does it produce verdigris when applied to the finest brass work.

The oil which is applied to leathern hose should be treated with a small quantity of rosin; for if it is sewed this will prevent rancidity destroying the stitches—if riveted, it will prevent the formation of verdigris, which takes place to a considerable extent whenever oil alone is used. Yours respectfully,

WM. BADDELEY.

29, Alfred street, Islington,
November 25, 1842.

## ON THE CONSTRUCTION AND USE OF COMMUTATION TABLES, FOR CALCULATING THE VALUES OF BENEFITS DEPENDING ON LIFE CONTINGENCIES.

### *Part V.—On the Present Values of Compound Benefits.*

Compound benefits are those which consist of two or more simple benefits; but the combinations which may be formed of these being obviously very numerous, it would be beside our present purpose to attempt giving a complete list of them. Our object will be, in selecting a few of them for illustration, to indicate the method of dealing with the more complicated cases, and also to prepare the way for the most general application of the Commutation Tables, which application will form the subject of the next and concluding paper. A very complete list of the formulæ for the more elementary of these benefits, is contained in Professor de Morgan's first paper on the subject; and as it is hoped that little difficulty will be experienced with these, after the illustrations to which our space limits us, we shall not scruple, as we have occasion, in the solution of any of the problems with which the present and the following paper will be occupied, to refer to any of the learned gentleman's formulæ, which we may not have deduced for ourselves. Our references will be made in the following manner, which is rendered necessary in consequence of his formulæ not forming one consecutive series.* Formula 10, on page 16, for example, will be denoted thus, [16,10]; formula 7 (2), on page 18, thus, [18,7 (2)]; and so on.*

As we are no longer to confine ourselves to benefits whose amount is £1, we again point attention to a remark made on page 455, to the effect that, when we have the present value of a benefit of £1, that of a like benefit of any other amount will be found by multiplying the first-named present value by the number of pounds in the amount in question. As it is convenient to have

* It may be of use here to point out a few typographical errors in Professor de Morgan's papers, which might otherwise embarrass the student.

| | | | | |
|---|---|---|---|---|
| First paper, page 11, | line 22, | for $(A+\overline{n-1}\,h)$, | read, $(A+\overline{n-1}\,H)$. | |
| | 16, | 29, | $(a+(n-1)h$, | $a\pm(n-1)h$. |
| | 17, | last, | $SC(x-1)$, | $SC(x+h-1)$. |
| | 21, | 30, | $M(x)$, | $R(x)$. |
| Second paper, | 2, | 25, | $(1-c)N(x,y)$, | $(1-c)N(x-1,y-1)$. |

Also, the terminating braces are omitted in the expressions [18,11] and [19,15 (2)] of the first paper.

distinctive symbols to represent the amounts of benefits of different kinds, we make use of the following for this purpose.

$s$. The amount of an endowment.
$a$. The annual rent of an annuity.
$h$. The annual increment or decrement of a variable annuity.
S. The amount of an endowment assurance.
A. The amount of an assurance.
H. The annual increment or decrement of a variable assurance.

Perhaps we may require a few others. If so, we shall explain them as they are introduced.

Also, since the expression for the present value of a compound benefit is the sum of the expressions for the present values of the simple benefits of which it is composed; and since these are fractions having for their denominator $D(x)$, it will likewise, *generally*, be a fraction having the same denominator. We shall, therefore, to economise space, usually omit this common denominator; but it must be carefully remembered, that the expressions are incomplete without it. We have said that the expression for the present value of a compound benefit is *generally* of the form alluded to. The exception is, (De Morgan, I., pp. 14, 15,) when a part of the benefit depends on the unknown item of payment. In this case the expression takes another form. When it does so, it will be exhibited without abbreviation.

In what follows we shall no longer adhere to the formality of problems. For after reference, however, we shall number the expressions we deduce with Roman numerals, in continuation of the number at which we have arrived in the previous problems.

Referring to remark 4, made at the close of last paper, (page 493,) we further premise, that, benefits being divisible into the two classes of annuity benefits and assurance benefits, if we deduce the expression for a benefit belonging to one of these classes, it will obviously be unnecessary to do so for the corresponding benefit belonging to the other class, since the relation indicated in the remark quoted *always subsists*.

We proceed now to the more legitimate subject of our present paper.

The increasing benefits of which we have hitherto spoken are those in which the annual increase is equal to the first payment. But the Commutation Tables can also be applied to finding the value of increasing benefits, in which the annual increase is in no way dependent on the first payment; and also of decreasing benefits, with the like latitude as to the magnitude of the decrease.

Thus, a life annuity whose successive payments are to be £$a$, £$(a+h)$, £$(a+2h)$, £$(a+3h)$, &c., may be decomposed into the following annuities, viz., a life annuity of £$a$, and an annually increasing annuity, to be entered upon one year hence, of £$h$, £$2h$, £$3h$, &c. The present value of the first is, (Prob. II.), $a\,N(x)$, and of the second, (Prob. VII.), $h\,S(x+1)$. The present value of the compound benefit therefore is, $a\,N(x)+h\,S(x+1)$. In like manner it may be shown, that the present value of a life annuity whose successive payments are to be £$a$, £$(a-h)$, £$(a-2h)$, &c., is, $a\,N(x)-h\,S(x+1)$. The following formula will therefore include both cases, the upper sign having reference to the increasing, and the lower to the decreasing benefit.

$$a\,N(x) \pm h\,S(x+1) \quad \ldots \quad \text{(XIX.)}$$

By the remark on p. 493, already referred to, the formula for the corresponding assurance benefits will be,

$$A\,M(x) \pm H\,R(x+1) \quad \ldots \quad \text{XIX.}$$

According to what has been said above, we shall not usually give the formulæ for the two classes of benefits, since, as we have seen, the formulæ for the one class, are so readily derived from those for the other.

If in (XIX.) $a=h$, for the increasing benefit, that is, if the annual increase be equal to the first payment, the formula becomes,

$a\,N(x)+a\,S(x+1)=a\,[N(x)+S(x+1)]=a\,S(x)$, By (10); which agrees with (VI), as it ought to do.

While the above formula expresses, for every value of $a$ and $h$, the true values of the benefit, yet it must be observed, that in the case of the decreasing benefit, $h$ may be taken so large, that the annuitant (we confine our remark to the annuity, although it is equally applicable to the assurance benefit), if he live long enough, will have to pay instead of to receive. Thus, if a person aged 30 enter

upon a decreasing life annuity, whose successive payments are to be £10, £9, £8, &c., (that is, $a=10$, $h=1$,), it is evident that the 10th payment will be £1, and the 11th 0. And since the annuity is for the whole life, the decrease still goes on, so that the 12th, 13th, 14th, &c. payments will be, $-$£1, $-$£2, $-$£3, &c. That is, the annuitant instead of having anything to receive, will have these sums to pay.

It may be also, that the present value of the payments to be thus made by the annuitant, will exceed that of the payments he will have previously received. This is indicated in the application of the formula to any particular case, by its numerical value in that case becoming negative, which will evidently be when $h\,S(x+1)$ is greater than $a\,N(x)$. A negative value presented by the formula, indicates that the *purchase money* for the benefit must be paid by the *seller*.

To avoid the inconvenience of the payments becoming negative, $h$ must never be taken larger than $\frac{a}{n}$, $n$ being any number not less than the number of years during which the annuity is to last. In the case of an annuity for the whole life, the least value of $n$ will be the difference between the age at which the annuity is entered upon, and the oldest age in the Table, when the last payment that can possibly be received will be £$h$.

If in (XIX.) we write $x+n$ for $x$, we are furnished, as in the case of the simple benefits, with the expression for the same benefit to be entered upon $n$ years hence. This expression is,

$$a\,N(x+n) \pm h\,S(x+n+1) \quad \ldots\ldots \quad \text{(XX.)}$$

It may also easily be deduced by decomposing the compound benefit.

The expression for the same benefit, to last $n$ years, is deduced in the following manner: This modification of the benefit consists of an annuity of £$a$, to be entered upon immediately and to last $n$ years, and of an increasing annuity of £$h$, £$2h$, £$3h$, &c., to be entered upon 1 year hence, and to last $n-1$ years, and which is to be either added to or subtracted from the other, according as the benefit whose value is sought is an increasing or a decreasing one. The present value of the first portion is, (IV.), $a\,[N(x)-N(x+n)]$; and that of the second portion is found as follows: the present value of an increasing annuity of £$h$, £$2h$, £$3h$, &c., to be entered upon in $k$ years, and to last $n$ years, is, by the Table on p. 492, $h[S(x+k)-S(x+k+n)-n\,N(x+k+n)]$. If, therefore, in this expression, we substitute 1 for $k$, and $n-1$ for $n$, we shall adapt it to our present purpose. Making these substitutions, the expression becomes, $h\,[S(x+1)-S(x+n)-(n-1)\,N(x+n)]$. But $(n-1)\,N(x+n) = n\,N(x+n) - N(x+n)$. Hence the expression becomes, $h\,[S(x+1)+N(x+n)-S(x+n)-n\,N(x+n)]$. But, by (10.), $N(x+n) - S(x+n) = -S(x+n+1)$. Therefore, the expression becomes finally, $h\,[S(x+1)-S(x+n+1)-n\,N(x+n)]$. And if to this we connect by the proper sign the expression for the present value of the first portion of the benefit, we have as the expression sought,

$$a\,[N(x)-N(x+n)] \pm h\,[S(x+1)-S(x+n+1)-n\,N(x+n)] \quad \ldots\ldots \quad \text{(XXI.)}$$

This expression may also be deduced in a somewhat different manner, which, as our object is illustration, we likewise insert. The benefit under consideration evidently admits of decomposition into the two following simpler benefits, viz., (confining ourselves, for perspicuity, to the increasing benefit,) a uniform annuity of £$(a-h)$ for $n$ years, and an increasing annuity of £$h$, £$2h$, &c., also for $n$ years, and both to be entered upon immediately. The present value of the first is, (IV.), $(a-h)\,[N(x)-N(x+n)]$; and of the second, (VIII.), $h[S(x)-S(x+n)-n\,N(x+n)]$. Adding these expressions, we have,

$$(a-h)\,[N(x)-N(x+n)]+h\,[S(x)-S(x+n)-n\,N(x+n)] =$$
$$a\,[N(x)-N(x+n)]-h\,[N(x)-N(x+n)]+h\,[S(x)-S(x+n)-n\,N(x+n)] =$$
$$a\,[N(x)-N(x+n)]+h\,[S(x)-N(x)-S(x+n)+N(x+n)-n\,N(x+n)].$$

Now by (10.), $S(x)-N(x)=S(x+1)$, and $S(x+n)+N(x+n)=S(x+n+1)$. Hence, the expression becomes, as before,

$$a\,[N(x)-N(x+n)]+h\,[S(x+1)-S(x+n+1)-n\,N(x+n)].$$

It will be seen, on comparing this expression with (XIX.), that it does not follow the same law as the simple benefits in passing from the expression for the

value of a benefit to last the whole life to that for the value of the same benefit to last $n$ years. Did the law referred to hold here, the signature of N, in the coefficient of $h$, would be $(x+n+1)$. (See De Morgan, I., page 21.)

We shall not seek to deduce here any more of Professor De Morgan's formulæ. We leave the others as a most improving exercise for the student, and pass on to the consideration of a few miscellaneous benefits.

£A are to be received by $(x)$ or his representatives at the end of $n$ years, if he be then alive, or at the end of the year in which he dies, if that event take place before the expiry of the $n$ years. Required the present value of the benefit. This benefit is evidently equivalent to an endowment of £A, payable in $n$ years, and a temporary assurance of the same amount, to last $n$ years. Its present value therefore is, by (I.) and (XIII.),

$$A\,[D\,(x)+M\,(x)-M\,(x+n)].\quad \text{(XXII.)}$$

This is a benefit of very frequent occurrence in practice. Several of the companies publish tables of the equivalent annual premiums, the method of finding which will be shown in our next paper.

Required the present value of a life assurance of £A on $(x)$, with which the sum paid is to be returned.

If we call the present value of this benefit P, then £$(A+P)$ will be the sum to be received at death; the benefit, therefore, will be a life assurance of £$(A+P)$, the present value of which is, (using the denominator in this case),

$\dfrac{(A+P)\,M\,(x)}{D\,(x)}$. And, by condition, we have, $P=\dfrac{(A+P)\,M\,(x)}{D\,(x)}$ $\therefore$ $P\,D\,(x)=A\,M\,(x)+P\,M\,(x)$. By transposition, $P\,[D\,(x)-M\,(x)]=A\,M\,(x)$. Whence,

$$P=\frac{A\,M\,(x)}{D\,(x)-M\,(x)}\;\ldots\ldots\;\text{(XXIII.)}$$

If at death, along with the sum assured, the sum paid is to be returned, with simple interest upon it from the date of payment, the sum to be received, if death take place in the first year, will be $A+(1+r)\,P$, if in the second, $A+(1+2r)\,P$, if in the third,

$$A+(1+3r)\,P,\ \&c.,$$

$r$ denoting the interest of £1 for a year. The benefit, therefore, is a life assurance of $A+(1+r)\,P$, increasing annually by $r\,P$; and the expression for the present value will be, by (XIX.),

$$\frac{[A+(1+r)\,P]\,M\,(x)+r\,P\,R\,(x+1)}{D\,(x)}.$$

Equating this to P, as in the last case, we should find,

$$P=\frac{A\,M\,(x)}{D\,(x)-(1+r)\,M\,(x)-r\,R\,(x+1)}\;\ldots\;\text{(XXIV.)}$$

This and the preceding case illustrate a remark made towards the commencement of the present paper, that when a portion of the benefit depends on the unknown (that is, unknown till the equation is solved) item of payment, the denominator of the expression for the present value is no longer restricted to $D\,(x)$. These and such like cases, however, belong more properly to that portion of the subject which will be treated in the succeeding paper.

The annual rent of an annuity upon $(x)$ is to be $a$ for the first $k$ years, $b$ for the next $m$ years, $c$ for the next $n$ years, and $d$ for the remainder of life. Required its present value.

Column S will not serve our turn in this case, since that column is applicable only when the variation in the payments is annual, and equable throughout the whole duration of the annuity. The problem, as proposed, has no such limitations; and we must therefore find the present values of the separate portions of the annuity, and add them together for the whole present value required.

The annuity consists of four portions, the present value of the first of which is, by (IV.),

$$a[N\,(x)-N\,(x+k)];$$

Of the second, by (V). $\quad b[N\,(x+k)-N\,(x+k+m)]$;

third, by (V.) $\quad c[N\,(x+k+m)-N\,(x+k+m+n)]$; and of the

fourth, by (III.) $\quad d\,N\,(x+k+m+n)$;

and the sum of these, [divided, as usual, by $D\,(x)$,] is the present value required. This sum is,

$$a[N\,(x)-N\,(x+k)]+b[N(x+k)-N(x+k+m)]+c[N(x+k+m)-N(x+k+m+n)]+d\,N\,(x+k+m+n)=$$
$$a\,N\,(x)+(b-a)\,N\,(x+k)+(c-b)\,N\,(x+k+m)+(d-c)\,N\,(x+k+m+n)\;.\;.\;\text{(XXV.)}$$

This expression shows, as will likewise readily appear from other considerations, that the benefit proposed admits of decomposition into the four following portions, viz., a life annuity of £$a$, and three deferred annuities of £$(b-a)$, £$(c-b)$, and £$(d-c.)$ to be entered upon respectively at intervals of $k$, $m$, and $n$ years. Also, that if $b$, $c$, and $d$ be respectively greater than $a$, $b$, and $c$, the payments will increase at the expiry of each term, and *vice versa*. If we adopt the former supposition, and suppose also $b-a=c-b=d-c=h$, that is, that the annual rents of the deferred annuities are equal, the expression will become,

$$a\,\mathrm{N}\,(x)+h\left[\mathrm{N}\,(x+k)+\mathrm{N}\,(x+k+m)+\mathrm{N}\,(x+k+m+n)\right]; \quad . \; . \; . \quad \text{(XXVI.)}$$

and if we farther suppose $k=m=n=1$, that is, that this uniform increase takes place at intervals of one year, it will become,

$$a\,\mathrm{N}\,(x)+h\left[\mathrm{N}\,(x+1)+\mathrm{N}\,(x+2)+\mathrm{N}\,(x+3)\right],$$

which, by (6), is equal to $a\,\mathrm{N}\,(x)+h\left[\mathrm{S}\,(x+1)-\mathrm{S}\,(x+4)\right]$.

And this is the expression we should have derived for the benefit, subject to these restrictions, and for the particular case in which $n=4$, from the formula [16,12].

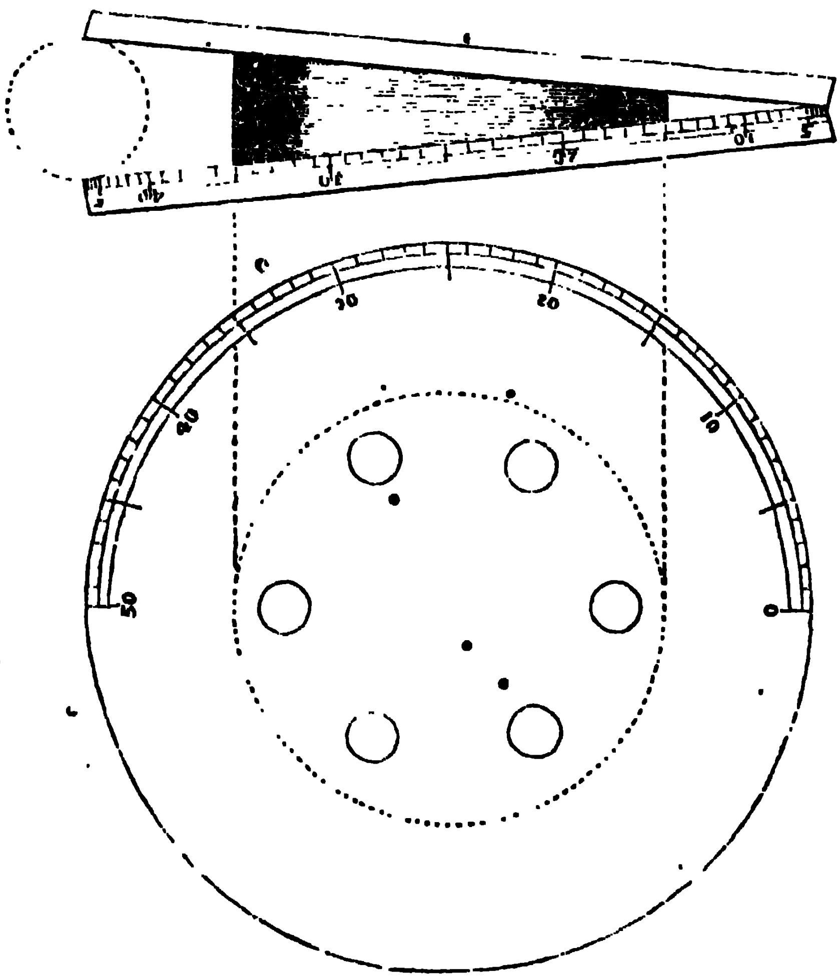
Here, for the present, we close our remarks.

G.

Hermes street, Pontonville.

## STANDARD WIRE-GAUGES.

Fig. 1.




Sir,—The advanced state of the mechanical arts, and the extreme accuracy now required in the execution of apparatus and machinery, have rendered necessary a corresponding improvement in the elementary tools, and in gauges; this want has been, in many cases, supplied in the most satisfactory manner, as, for

Fig. 2.

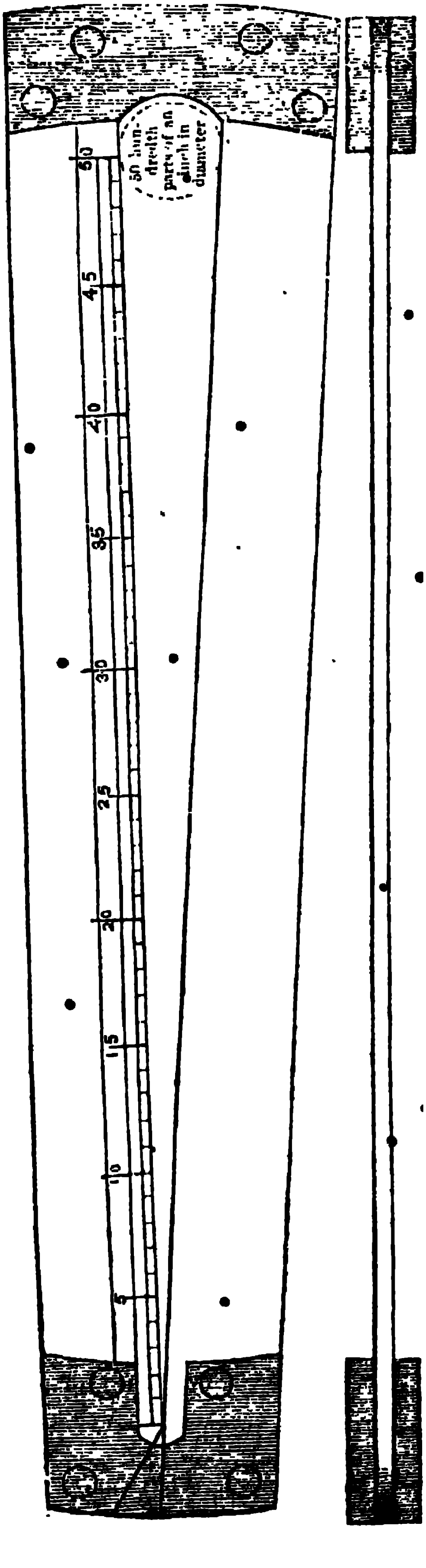
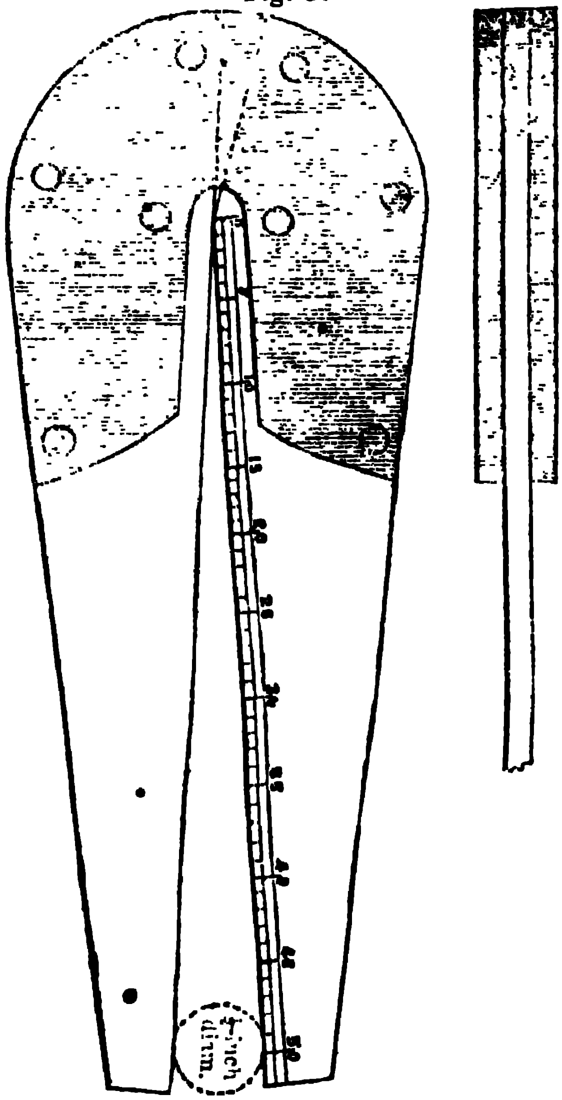



Fig. 3.



example, by the perfect straight edges, the plane surfaces, and the cylindric gauges of Whitworth; yet one sort of gauge, that in the most frequent use, remains to this day in all its original rudeness and deficiency. I allude to what is called the wire-gauge, of which, from the mode of their construction, no two specimens are quite alike, even when new, and on which no reliance can be placed, where rigid accuracy is aimed at. Besides this, the arbitrary notation assumed for the sizes, (in some cases the low numbers being affixed to the largest diameters, and in other cases the scale being inverted,) often leads to mistakes.

As few publications have a wider circulation, or a more instructive influence on our intelligent mechanics than your Magazine, I venture through your means to call their attention to this circumstance, and to suggest the general adoption of a gauge of such simplicity of construction, that they may be made by any one with

great accuracy; and of which the notation of the scale will indicate actual dimensions in decimals, centesimals, or millesimals of an inch, according to the way they may be put together for the peculiar use of the parties requiring them. If such gauges were to be introduced into workshops, they would be found useful in a great variety of cases, besides sizing wire or plate; and as, wherever made, they would all correspond, written orders might be communicated to a distance, with the surety of no mistake arising from discrepancy of measures.

I inclose drawings of different forms which may be given to such a gauge; they are all set to indicate centesimals of an inch, but, when wanted for the gauging of very small diameters, the open end of the instrument being set to ·05 instead of to ·5, it is evident that the same scale, which in the drawing indicates hundredths of an inch, would then represent thousandth parts.

A counterpart of this gauge would be useful in cases where the diameters of holes are to be taken; this, of course, may be made of a slip of steel plate, half-an-inch broad at one end, and tapering (by straight line sides) to a point. If the sides, whether long or short, be divided into 50, the scale will then indicate hundredths of an inch, as in the other case; and if this gauge, on being inserted into a hole, penetrate to the division marked 30, a rod which is arrested at the division 30 on the other gauge will exactly fill the hole.

I am, Sir, your obedient servant,

K. H.

MOSELEY'S MECHANICAL PRINCIPLES OF ENGINEERING AND ARCHITECTURE.—SECOND NOTICE.

The "Theory of the Stability of Structures" next occupies Professor Moseley's attention. The equilibrium of any system of bodies—as, for example, a structure of uncemented stones—depends upon two conditions; first, in order that there shall be no turning over, that if a line be drawn through the resisting points of the resultant pressures upon the contiguous surfaces, that line shall be all *within* the mass of the structure, or, in other words, that it shall actually go through each joint of the structure, avoiding none; and, second, in order that there shall be no slipping, that the line of direction of the resultant of the pressures upon each of the surfaces in contact shall be within the surface of a right cone, having for its axis the normal (perpendicular) to the common surface of contact, and for its vertical angle twice that whose tangent is the coefficient of the friction of the surfaces. The one line is called by Mr. Moseley the *line of resistance;* and he has every right, which parentage as well as nomenclatural propriety can confer, to give it this name, for he was the first to investigate its properties, (Cambridge Phil. Trans., volume vi.,) and to show that it is, in many important respects, different from the curve of equilibrium of the older writers. The other line is already known to geometrical investigation by the name of the *line of pressure.*

The distance of the line of resistance from the extrados (external face) of a structure, at that point where it most nearly approaches it, Mr. Moseley takes as a measure of the stability of the structure, and calls it the *modulus of stability.* We agree with him in thinking that this measure or standard of stability is of readier application than the coefficient of stability used by preceding writers. It is a simple rule, and easy to bear in mind, that the more remote the direction of the line of resistance is from the extrados, the less, under all ordinary circumstances of pressure, will the chance of settlement or downfall be. Mr. Moseley very candidly admits, that the idea of this modulus of stability was suggested to him by a rule in fortification, ascribed to Vauban—namely, that, in the construction of revêtement walls, the point where the line of resistances intersects the base of the wall should be distant from its extrados $\frac{4}{9}$ths of the distance between the extrados at the base and a vertical line drawn through the centre of gravity.

Professor Moseley proceeds to apply the preceding principles of construction to the various cases of Piers—Walls supported by counterforts and shores—Buttresses—and Walls supporting the thrust of roofs and the weight of floors—all of which are here, for the first time, (we believe,) treated mathe-

matically. The Professor would add much to the value of this part of his work, if, in his next edition, he would extend his investigation to the new case of the suspension roofs first proposed for adoption in this country by Mr. Hansom, and already adopted in one large building (a panorama) in Paris.

In treating of Earth Works and Revêtement Walls, the author follows Coulomb and Poncelet very closely; but, by availing himself throughout of the properties of his own "limiting angle of resistance," he has very much simplified their results.

The properties of the Arch are discussed upon principles first laid down by Mr. Moseley in the Memoir, of which we have before spoken, on "the stability of a system of bodies in contact," printed in the Cambridge Phil. Transactions. Hitherto—down even to so late a period as the publications of Whewell—the theory of the arch has been this, that when the line of pressure is every where perpendicular to the joints of the voussoirs, (which is what is technically called, *being equilibrated*,) the arch would stand though there were no friction of the surfaces in contact. But while Mr. Moseley allows that it is impossible to conceive any arrangement of the parts of an arch by which its stability can be more effectually secured, ***so far as the tendency of its voussoirs to slide upon one another is concerned***, he objects very justly, that there is, probably, no practical case in which that tendency *really affects the equilibrium*. "So great is the *limiting angle of resistance*, in respect to all the kinds of stone used in the construction of arches, that it would perhaps be *difficult* to construct an arch, the resultant pressure upon any of the joints of which, above the springing, should be *without* this angle, or that should yield by the slipping of any of its voussoirs."—Page 465. Mr. Moseley, therefore, considering the arch as a system of bodies in contact, which *reposes ultimately* upon the two resisting surfaces called the abutments, has thought that theory and practice might be better reconciled, by seeking in these abutments for the essential conditions of the stability of the entire structure.

"Traced to the abutment of the arch, the line of resistance ascertains the point where the direction of the resultant pressure intersects it, and the line of pressure determines the inclination to the vertical of that resultant; these elements determine all the conditions of the equilibrium of the abutments, *and therefore of the whole structure;* they associate themselves directly with the conditions of the loading of the arch, and enable us so to distribute it, as to throw the points of rupture into any given position on the intrados, and give to the line of resistance any direction which shall best conduce to the stability of the structure; from known dimensions, and a known loading of the arch, they determine the dimensions of piers, which will support it; or, conversely, from known dimensions of the piers they ascertain the dimensions and loading of the arch, which may be safely made to span the space between them."—Page 465.

Mr. Moseley makes, nevertheless, this important reservation in favour of the old theory.

"Although a true mathematical adjustment of the surfaces of the voussoirs to one another can have no existence in practice when the voussoirs are put together without cement, yet may it obtain in the cemented arch. The cement, by reason of its yielding qualities when fresh, is made to enter into so intimate a contact with the surfaces of the stones between which it is interposed, that it takes when dry, in respect to each joint, (abstraction being made of its *adhesive* properties,) the character of an exceedingly thin voussoir, having its surfaces mathematically adjusted to those of the adjacent voussoirs; so that if we imagine, not the adhesive properties of the cement of an arch, but only those which tend to the more uniform diffusion of the pressures through its mass, to enter into the conditions of its equilibrium, these equations embrace the entire theory of the cemented arch."—Page 479.

"In its settlement, an arch is liable to disruption in some of those directions in which this adhesion (of the voussoirs to one another) might be *necessary to its stability*. That old principle, then, which assigns to it such properties as would cause it to stand firmly, did no such adhesion exist, *will always retain its authority with the judicious engineer*."—Page 478.

M. Coulomb has his new theory of the arch, as well as Mr. Moseley; but of this we need not here say more than that, though

more profound *looking*, it leads to precisely the same practical results, which, considering Coulomb's eminence in the philosophical world, is perhaps as high a compliment as could be paid to the judgment and sagacity of our English Professor. The agreement between the two theories is the more remarkable, that that of Coulomb is stated to have been unknown to Mr. Moseley at the time, when it was first published in the Cambridge Philosophical Transactions.

(*To be continued in our next.*)

PROGRESS OF FOREIGN SCIENCE.

*Process for the preparation of Artificial Ultramarine.*

This beautiful pigment, now coming into extensive use in this country, has been for some time an article of large consumption and manufacture in France and Germany; and such is the brilliancy and power of its colour, that it is found more economical by the paper-stainers to use it than cobalt, even though the price of the latter be greatly inferior.

A new process has recently been published for its preparation by Mr. Tisernon. It chiefly differs from those already known by the use of a small portion of arsenic, with the sulphur employed. The proportions used by him, are

| | | |
|---|---|---|
| Finely levigated pipeclay | 100 | |
| Precipitated alumina, (estimated in the dry state,) but to be used in the gelatinous condition | 7 | |
| Dried carbonate of soda | 1075 | (crystallized.) |
| Flour of sulphur | 221 | |
| Sulphuret of arsenic | 5 | |

The mixture of these must be made with the greatest care. Into the carbonate of soda, melted in its water of crystallization, the sulphuret of arsenic in powder is to be projected, and when it is in part decomposed, the gelatinous alumina is to be added; this is obtained from the alum of commerce precipitated by carbonate of soda, and the precipitate worked on a filter of linen with pure water. Lastly, the pipeclay and sulphur, previously mixed, are to be added. The whole mixture is to be put into a covered crucible, heated cautiously to drive off the rest of the water, and then brought to a red heat. The fire must be so managed that while the mass shall be agglutinated together it must not be liquified.

After cooling, the mass is to be heated again, to drive off as much more sulphur as possible, and then ground and worked with water. The finest portions require to be separated by the filter.

When the operation has been well conducted, the whole mass is good colour, but if it has been suffered to melt it contains brown veins.

The colour is not to be worked on the filter, from which it is to be removed to a covered basin and dried; and the colour is improved by a strong heat, even a dull red.

*Improvement in the manufacture of Silvered Copper Plates, for Daguerreotype, and for all purposes to which Plated Copper is applicable.*

M. Becquerel has communicated briefly to the Academy of Sciences an invention, or rather application, of the electro-type process to the above purposes, by M. Belfield Lefevre, which seems of considerable manufacturing importance.

Upon a plate of polished copper a coat of pure silver is precipitated, of any required thickness, and above this another and greater thickness of copper is again precipitated. Means are taken that the silver shall be detachable from the plate on which it is formed, while by a particular method the adhesion of the precipitated copper to the silver is insured. The result is a compound plate, having upon its silver surface all the polish of the copper matrix.

The specimen plate, presented to the Academy, was perfectly malleable, and would bear bending or lamination well.

It is to be regretted that the particulars are not given of the method by which the non-adherence of the silver and matrix, and the certainty of adhesion of the former with the precipitated copper, are insured.

*Elasticity and Tenacity of Metals.*

Some very important researches upon this subject have recently been published by M. Wertheim. The author commences by showing, that such questions as the constancy or variability of the coefficient of elasticity of the same substance, placed in different circumstances—changes

of mechanical treatment—annealing variation of temperature as affecting this co-efficient—the relation between the theoretic and real velocity of sound, connecting itself with this subject as a case of vibration—the laws of permanent displacement and different positions of equilibrium, (of molecules namely)—the existance of a true limit to elasticity, and to maximum extension, (before rupture,)—the obtaining numerical values for all these, and determining their relations with the chemical constitution of bodies, have as yet received imperfect solutions at the hands of physical investigators.

He gives a brief, but valuable historical sketch of what has been done in these departments by his predecessors, so far as he has had any; for in some instances, we have had as yet no researches, as in the case of the changes which the elasticity of metals undergoes by variation of temperature. The results of Coulomb and Lagerheilm, who found the same co-efficient of elasticity for steel and iron, do not agree with those of the generally accurate Poncelet.

The coefficients of elasticity have been determined by various methods and by numerous authors—for lead, zink, silver, platina, copper, iron, and steel. In relating the various investigations that have been made on metallic cohesion, as effected by temperature, the author does not seem aware of the extensive and valuable series made by the Committee on Steam Boiler Explosions of the Franklin Institute of America, nor of Mr. Mallet's results upon the cohesion of the different alloys of copper and zink, and copper and tin, published by the British Association.

The author's present researches relate solely to simple metals, operated on in a state of chemical purity—viz., to lead, tin, cadmium, gold, silver, zink, platina, copper, iron and steel. When possible, each metal was cast, hammered, drawn out, and annealed; in each of these stages its density was taken, and then its coefficient of elasticity determined with the corresponding velocity of sound by three different methods—by transversal vibrations—by longitudinal vibrations, and by direct extension.

The number of transversal vibrations per second was determined by the method of Duhamel. For marking vibrations, a small marker, attached to the extremity of the rod experimented on, produced a mark upon a disk covered with smoke from a lamp. A slow uniform motion being given to the disk, he was enabled to determine the vibrations in time by comparing them with those of a normal diapason, which made exactly 256 vibrations a second—he could thus determine the time to $\frac{1}{2560}$ of a second nearly. The number of longitudinal vibrations was determined by means of a differential sonometre, referred to the same diapason, and its exactness ascertained by a direct observation of the longitudinal vibrations marked by two rods of two meters in length. The result showed a difference of not more than 3 to 7 in a thousand vibrations. Lastly, the rods and wires were submitted to constantly-increased loads, in a suitable apparatus. The amounts of stretching, both during the load being sustained, and after its removal, were observed and read off to the hundreth of a millimeter; and thus not only the co-efficient of elasticity was nearly determined for each position of equilibrium of the rod or wire, (that is, for each period when the elastic and cohesive forces of the molecules came into equilibrium with the load,) but all that relates to the limit of elasticity, to the maximum stretching and cohesion, was observed, and after each fracture the density and elasticity of the fragments were again determined. Finally, all the experiments on stretching were repeated at temperatures of 100° and 200° cent.

The following are the principal conclusions arrived at:—

1. The co-efficient of elasticity is not constant for the same metal; all conditions which increase its density augment the coefficient, and conversely.

2. Both longitudinal and transversal vibrations give the same results as to co-efficients of elasticity.

3. Larger co-efficients of elasticity are obtained by the method of vibrations than by stretching. This difference arises from the acceleration of motion produced by the heat disengaged in the latter mode.

4. Sound in solids is due to waves with condensation, and we can, by Duhamel's formula, use the ratio between the theoretic and the real velocity of sound, to find the ratio between the specific heat under a constant pressure, and that under a constant volume. This ratio is greater for annealed than for unannealed metals.

5. The co-efficient of elasticity diminishes with elevation of temperature, in a ratio more rapid than is deducible from the corresponding expansion.

6. Magnetization does not sensibly change the elasticity of iron.

7. The stretching of wires by successive loads, changes their density but very slightly; hence, the co-efficient of elasticity varies very little in the successive positions of equilibrium, and such is the fact, until the point of rupture is closely approached. The law of De Gerstner, is therefore thus confirmed, for all metals which attain sensibly a position of equilibrium after having once passed their elastic limits.

8. The stretching takes place not by starts, or *per saltum*, but continuously; and by modifying suitably the load and the time of its action, we can produce any amount of permanent extension that may be wished for.

9. There exists no true limit of elasticity, and if we do not observe permanent elongation, at the first, or smallest loads imposed, it is merely because sufficient time is not allowed, or that the instrument of observation is not sufficiently sensible.

It may be remarked that this result fully coincides with the observations, up to this time made by Messrs. Fairbarin, and Eaton Hodskinson, of Manchester, upon the gradual effects of a load nearly equal to the breaking weight upon iron beams, which all appear to be very slowly but continuously yielding to the strain.

The amount of the maximum elongation and of the cohesion conditional, are stated by the author to depend much on the way in which the experiment is made; they are greatest as the loading is most slow and gentle. Hence M. Lagerheilm's determinations of the greatest and least permanent elongations are without foundation.

10. The resistance to rupture is considerably diminished by annealing. The elevation of temperature to 200° cent. does not much diminish the cohesion of previously annealed metals.

The last result is not fully borne out by the elaborate and accurate experiments made by the Committee of the Franklin Institute upon the change of cohesion due to change of temperature; their results for iron are to the mechanical engineer of extreme importance, and it is to be regretted that they are so little known in these countries.

From the foregoing experimental data, the author proceeds to establish relations between the co-efficient of elasticity, and the molecular constitution of each body, to compare the results of calculation with those of experiment.

Poisson has obtained the following general expression for the co-efficient of elasticity.

$$q = \frac{\pi}{g} \sum_{r=a}^{r=\infty} \frac{r^5}{a^5} \frac{d\frac{1}{r}fr}{dr}$$

In this complex expression $a$ = the mean distance of the molecules, $r$ = the radius of activity of the same, *i.e.* of attraction and repulsion; the function $fr$ giving the resultant of the simultaneous action of both forces due to heat.

To find $a$, it is admitted that the weight of each molecule is expressed by its atomic weight,—an hypothesis corroborated by various researches on specific heat.

The relative number of atoms contained in the same volume, is had by dividing the specific gravity by the atomic weight. The inverse of the cube root of this number is the measure of the distance of the molecules of each metal in its different states, that is to say, the value of $a$. There remains, therefore, no unknown quantity, but the function $fr$ to be deduced.

As consequences from this formula, $q$ increases as $a$ diminishes. This is sustained by the author's experiments, but our means of producing compression and dilatation are too limited to be able fully to confirm the fact.

By elevation of temperature the co-efficient of elasticity decreases so rapidly that the product of $q\ a^7$, is always smaller than the ordinary temperature. The function $fr$ must therefore involve the temperature.

The different metals do not follow the same order, either in the proximity of their molecules, their co-efficient of elasticity, or their power of conveying sound in relation to its intensity. The last point has been approximately known by the experiments of Perolle.

Platina alone is placed between copper and iron, in respect to its elasticity, while

it stands between zink and copper as to the distances of its molecules.

The product of the co-efficient of elasticity by the seventh power of the relative mean distance of the molecules is the same for almost all metals, (*i.e.* those tried.) This is almost exact for lead, cadmium, gold, silver, zink, and iron; copper gives greater, and tin and platina less products.

If this relation were strictly general, it might be concluded that the resultant of the attractive molecular force, and of the repulsive force of heat decreased in the inverse ratio of the fifth power of the distance.

But this is not confirmed for all the metals; we can only therefore conclude so far, that this resultant decreases, as calculation leads us to suppose, much more rapidly than in the ratio of the inverse square of the distance.

These results are of great scientific interest, and are at this juncture of some practical importance as bearing upon the questions of changes in the molecular structure of iron, when in use for railway axles, &c., and thus exposed to shocks, changes of temperature, and supposed magnetization.

The preceding results show that some of the conclusions arrived at, or rather some of those *jumped at* upon this subject, both at home and abroad, are destitute of any foundation, and that one of the remedies suggested to meet an unproved and imaginary evil—namely, the proposition to anneal all railway axles, not once, but frequently, to prevent their texture from becoming brittle and crystaline, must be attended with a great loss of strength and of elasticity, and may do much more harm than good, even if the disease the medicine is proposed for, were proved to exist, which it has never yet been.

Like many papers by German authors, this of M. Wertheim advances so far into the theoretic considerations of his subject, as perhaps to bear an almost repulsive air to many English readers, at least amongst those connected with practical mechanical pursuits; but it is replete with matter for important practical deductions, and in its theoretic bearings touches those points which at this time, of all others, most interest the future progress of chemistry, whose connexion with physics alone seems to offer a chance of diminishing the number of our present fifty-four supposed elementary bodies.

R. M.

### MEDHURST'S COAL-WEIGHING MACHINE.

Sir,—Observing in your Journal, (No. 1000, October 8, 1842,) a description of a coal-weighing machine, from a correspondent at Cambridge, we beg to inform you that we are the *inventors* of *that machine*, and also extensive manufacturers of the same. The dimensions and proportions given in the description are precisely the same as in those we first made. A great many were sent to *Cambridge*, (from which place your correspondent dates his letter,) for the use of the coal-merchants, and each machine had our name cast on the platform.

We are, Sir,
Your obedient servants,
T. F. & T. MEDHURST,
Weighing-machine Manufacturers.

1, Denmark-street, Soho, London.
November 23, 1842.

### MR. DREDGE'S IRON SUSPENSION-BRIDGE AT FROME.

Sir,—Since addressing you last month, I have erected the bridge at Frome: its length is fifty-one feet, and breadth seven feet three inches. It is erected in the place where a dilapidated wooden bridge stood, whose cost was double that of the new iron one. The power of the bridge is above one hundred tons, the weight of the chains less than ten hundred pounds, and it occupied four men only four days in construction. On the first day it was commenced, it was so far finished as to admit any common loads to pass over it.

I am, Sir,
Your humble servant,
JAMES DREDGE.

Bath, November 25, 1842.

### ADDITIONAL LIST OF ENGLISH PATENTS GRANTED BETWEEN THE 2ND OF SEPTEMBER, 1842, AND THE 25TH OF NOVEMBER, 1842.

[*The following did not reach us in time for our last publication.*]

Felix Napoleon Target, of Blackheath, gent., Leon Castelain, of Back-lane, Shadwell, chemist; and Adolphe Aubril, of Back-lane, aforesaid, artist, for a new method of refining or manufacturing sugar. Six months; November 25.

James Smith, of Coventry, pattern drawer, reeder and card stamper, for improvements in weaving ribbons and other ornamented fabrics. Six months; November 25.

Charles Heard Wild, of Birmingham, engineer, for an improved mode of constructing floors for fire-proof buildings. Six months, November 25.

Isham Baggs, of Whatton-street, Middlesex, chemist, for improvements in producing light. Six months; November 25.

Frederick Oldfield Ward, of Saint Martin's-lane, gent.; and Mark Freeman, of Sutton, Surrey, gent., for improvements in candlesticks, apparatus, and instruments employed in the use of candles and rush-lights. Six months; November 25.

Pandia Theodore Ralli, of Finsbury Circus, wine merchant, for improvements in the construction of railway and other carriages, and in apparatus connected therewith. (Being a communication.) Six months; November 25.

William Henry Fox Talbot, of Laycock Abbey, Wilts, Esq., for improvements in coating or covering metals with other metals. Six months; November 25.

## LIST OF PATENTS GRANTED FOR SCOTLAND FROM THE 26TH OF OCTOBER, TO THE 21ST OF NOVEMBER, 1842.

John Varley, of Colne, Lancaster, engineer; and Edmoudson Varley, of the same place, cotton manufacturer, for certain improvements in steam-engines. Sealed, October 26.

James Hyde, of Duckenfield, Cheshire, mechanic; and John Hyde, of the same place, cotton spinner and manufacturer, for a certain improvement or improvements in the machinery used for preparing cotton, wool, silk, flax, and similar fibrous materials for spinning. Sealed, November 3.

John Clay, of Cottingham, York, gent., and Frederick Rosenborg, of Sculcoates, York, gent., for improvements in arranging and setting up types for printing. Sealed, November 3.

James Pilbrow, of Tottenham Green, Middlesex, engineer, for certain improvements in the application of steam, air, and other vapours and gaseous agents, to the production of motive power, by which the same is effected. Sealed, November 7.

Francis Roubiliac Conder, of Highgate, Middlesex, C. E., for improvements in the cutting and shaping of wood, and in the machinery for that purpose. (Being a communication.) Sealed, November 9.

John Mitchell, of Birmingham, Warwick, steel pen manufacturer, for a certain improvement in the manufacture of metallic pens, and a certain improvement in the manufacture of pen-holders. Sealed, November 11.

Henry Clarke, of Drogheda, Louth, Ireland, linen merchant, for improvements in machinery for lapping and folding all descriptions of fabrics whether woven by hand, or power. Sealed, November 17.

John Spinks, the younger, of John-street, Bedford row, Middlesex, gent., for an improved apparatus for giving elasticity to certain parts of railway and other carriages requiring the same. (Being a communication.) Sealed, November 21.

### NOTES AND NOTICES.

*Another New Cement.*—Among the novelties recently introduced at the Adelaide Gallery entitled to notice, is a new cement in imitation of marble. It is well known that a cement, partly composed of marble dust, was used by the ancients in coating the columns and walls of their buildings. It is found in Italy and other genial climes, to be not inferior to their native marble on exposure to the effects of the atmosphere. The cement now under notice does not, however, contain any portion of marble dust, but is composed of gypsum deprived of its water of crystallization by great heat, and is then saturated with a solution of alum of proper strength. The mixture being then subjected to intense heat, is equal in durability and capability of polish and colour to the finest marble. Some beautiful specimens were shown a few evenings since, and the lecturer observed that the sulphate of alum, being the base on which most colours were struck, and alum the mordant used to fix them, afforded a sufficient proof of the aptitude of the cement to receive any of the colours in imitation of marbles, granite, woods, &c.—*Mining Journal.*

*Microscopes.*—The Royal Society have offered a premium of 100*l.* for the best microscope which shall be delivered to the Society, at their apartments in Somerset House, before the 1st of May, 1843, to remain the property of the Society. The instrument is to be the best compound achromatic microscope, having not less than five different powers, with a micrometer, eye-piece, a condenser, and the usual accompanying apparatus.

*The Days of Alchemy not past.*—A literary journal of the last week contains an advertisement extraordinary under the head of "Hermetic Philosophy and Chemistry of the Ancients," in which a "Professor of long experience and research in both the ancient and modern chemical schools," offers, for the small trifle of *two hundred guineas*, to furnish "the philosophical student, or other pupil," "with a proper quantity of the requisite mercurial matter to operate for the profitable application of the hermetic science as *a source of wealth* to the fortunate operator in this mystical branch of metallurgic chemistry, *successfully* (?) practised by Flamel, Lilly, and other the adepto chemical philosophers of the middle ages." Only "*a few applicants*" are to be let into the making-money-at-will secret, because "the tedious and difficult elaboration of the necessary mercurial agent above mentioned (the Caducean mercury of the ancients) *prevents any but a very sparing dissemination of the matter!*" Whatever the advertiser's hermetic merits may be in other respects, it will not be disputed that so far as the humbug of the thing goes, he is a genuine *adept* of the old school.

*The Hot-blast Patent.*—This patent expired on the 11th of September for England, and on the 1st of October for Scotland, and has proved eminently successful to the inventor. Besides being of great national benefit, it has realized a sum of not less than 150,000*l.* to the patentees, and has placed John Beaumont Neilson high in the ranks of the benefactors of, not his country alone, but of mankind, iron being the most useful of metals, and its cheap production of immense importance in arts and manufactures, on which the conveniences and comforts of life depend.—*Times.*

*Huge Wire-rope.*—A friend of ours, who has just returned from Antwerp, informs us that he saw landing on the quays there, from a vessel arrived from Newcastle, a huge coil of wire-rope, which excited much astonishment. It was stated to be 5300 yards in length, and to weigh twelve tons, and he understood that it had been purchased by the Belgian Government for the celebrated inclined plane of the railway from Antwerp to Liege.—*Dundee Paper.*



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No. 1009.] SATURDAY, DECEMBER 10, 1842. [Price 3d.

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## KING'S STOVE-GRATE.

Fig. 1.

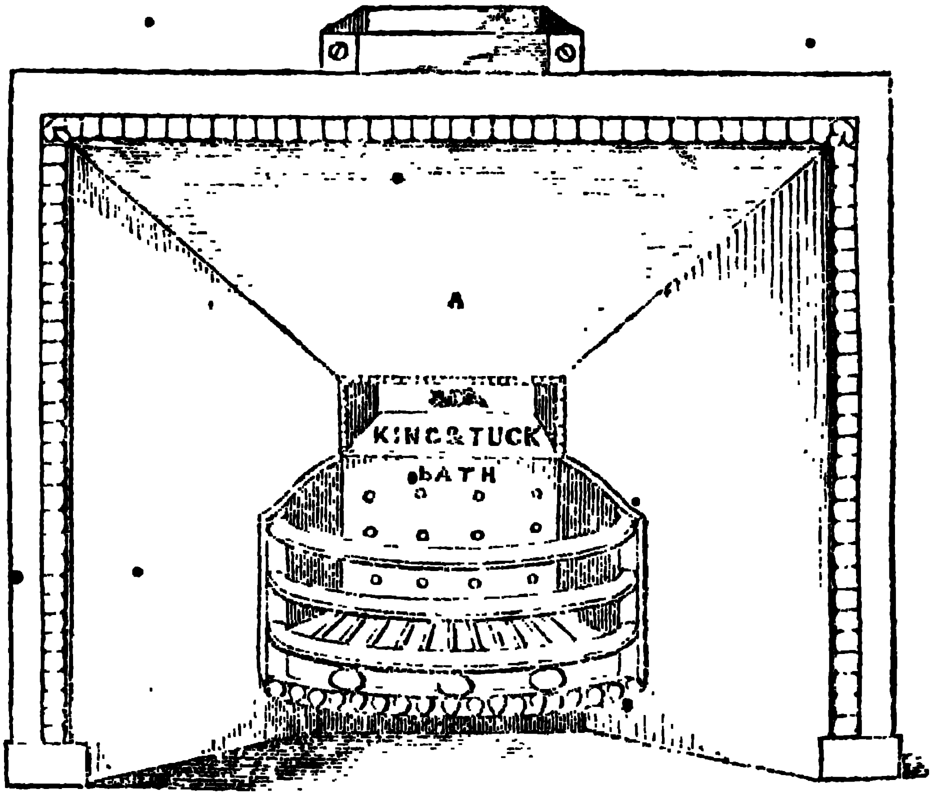
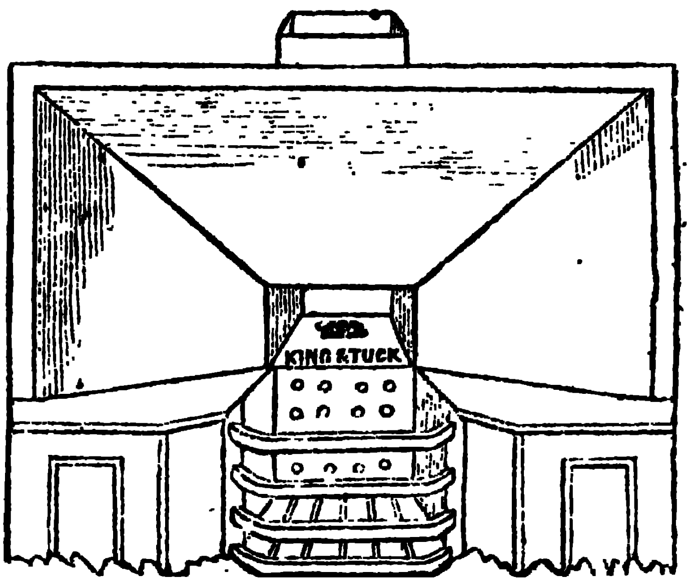



Fig. 2.



## KING'S STOVE-GRATE.

[Registered pursuant to Act 2 Vict. c. 17. No. 969. December 10, 1841.]

Sir,—Your correspondent, R. W. T., expresses a desire to see stove-grates constructed upon better principles than those in general use, in order that more perfect combustion may be attained; and another, T. H. B., gives a description of a grate most likely to carry out R. W. T.'s wishes.' (See present vol., p. 494.) T. H. B.'s suggestions are very correct, though I presume they are founded more on general considerations of fitness than on actual observation. About a year ago, I constructed a register stove grate, which seems to me, (with submission,) to carry out R. W. T.'s views more complete than that of T. H. B., and I have since had many unquestionable proofs of its efficiency. I am, therefore, induced to send you a description of the same, for the information of your correspondent, and also of your many other intelligent readers.

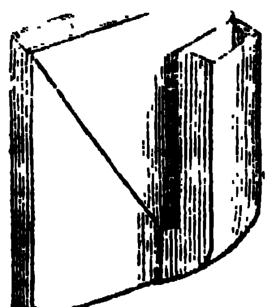
Fig. 1, of the accompanying engravings, shows my stove-grate which, in general appearance, is similar to the usual register grates; but will be found, on examination, to differ from them in the *deepness* of the bevelled sides and top, in the *smallness* of the aperture to take off the smoke, and in this aperture being situated at the *back*, immediately over the fire, and having a tube to convey it to the chimney. I was induced to construct this grate to carry off more perfectly the smoke into the chimney, and thereby cure what is generally called a "smoky chimney;" and *this it does with more certainty than any grate I have ever seen.* It produces also the more perfect combustion desired by R. W. T., whilst it fully proves the correctness of the statement made by T. H. B., viz., "*that a stove-grate of this description will not require more than one-half the usual consumption of coal, with a comfort not shown in the use of any others.*" It is not necessary, however, to bring them out beyond the chimney, as recommended by T. H. B.; for it may be fixed in the usual place, *within* the chimney-piece. The heat reflected by the sides will be found quite sufficient for warming a room; and, by leaving the back free from the masonry, an air-chamber would be formed, whence warm air might be conveyed in tubes to heat other apartments of a building. By a simply-arranged balanced sliding plate the flue is perfectly closed, to prevent the return smoke from other chimneys.

As the opening for the smoke is *small*, it may be asked, "how is the chimney to be swept?" I answer by stating, that the bevelled top plate, marked A, is made to be lifted off, thereby giving a much larger opening, and greater facility for sweeping by machinery than other grates.

In conclusion, I would observe, that the engraving, fig. 2, shows the same plan of construction applied to a common grate with hobs. I registered this under the name of "King's Calorific Smoke Conductor," as applicable to all kinds of grates. Rather a fine name, you may be ready to say; but, as it is intended to *conduct* the smoke horizontally into the chimney, and as it does this most effectually from the *conductor or tube being* HEATED, I think you will admit it is comprehensible, and not very inappropriate.

Fig. 3 shows a side view, exposing the flue. This may be made of thin sheet-

Fig. 3.



iron, and applied with great effect, at a *little cost*, to grates already fixed.

The stove, fig. 1, is, however, the most perfect of all, for *diffusing heat* with a *small portion of fuel*, and carrying off the smoke arising from the same.

I am, Sir,

Your obedient servant,

S. KING.

Bath, December 3, 1842.

## ON THE CONSTRUCTION AND USE OF COMMUTATION TABLES, FOR CALCULATING THE VALUES OF BENEFITS DEPENDING ON LIFE CONTINGENCIES.

### *Part* VI.—*On the most general application of the Commutation Tables.*

We have been occupied hitherto with the consideration of the present values, or single premiums, equivalent to benefits of various kinds. It is seldom, however, that benefits are paid for by a single premium. The more usual mode is by annual premiums, which may be either uniform or variable, and payable either during the whole life, or only for a specified number of years. It is necessary, therefore, now to show how the amounts of premiums, payable as described, may be found. The method of doing so constitutes the most general application of the Commutation Tables; and it is this application which most strikingly displays the great power of the method of computation we are endeavouring to illustrate, and its vast superiority to all other methods heretofore in use. It will be seen as we proceed, that the previous papers have been but preliminary to that which forms the subject of the present paper.

The principle upon which the application of the Tables that we are now to describe depends, is so simple, that some may be disposed to award but a small portion of merit to the person by whom it was first pointed out. But as we are of those who believe that the merit of a contrivance is to be estimated in proportion to the utility of the object it has in view, and the simplicity and efficiency of the means by which that object is attained; and as the possession of those qualities, in an eminent degree, by the contrivance in question, cannot be gainsaid, we take a very different view of the matter, and presume to think the contrivance one of very great merit.

It is to Professor de Morgan that we are indebted for the contrivance we have alluded to. Others before him had, doubtless, shown how most of the problems might be solved by the Commutation Tables; but it was reserved for him to devise a general principle equally applicable to all, and to exhibit an equation which should include in it almost every case, as regards both benefits and premiums, that can be proposed.*

We now proceed to explain the principle of this contrivance. The value of an annual premium whose continuance depends upon the continued existence of a given life, is evidently as legitimate a subject for computation by the Commutation Tables, as that of any of the benefits we have been considering. In fact, generally speaking, the only circumstances in regard to which a premium differs from an annuity for the same number of years, are, that the payments of the premium are usually made at the beginning of each year, while those of an annuity are made at the end; and that it is paid instead of being received by the person on whose life its continuance depends.

The last-mentioned circumstance evidently does not, in the slightest degree, affect the present value of the premium; and to the condition implied in the first we have already seen that the Commutation Tables are equally applicable as to the case of an annuity payable in the ordinary way. (See Problems II., III., and IV.)

If therefore we extend for a little the meaning of the term *benefit*, so as to include a payment or payments to be made by or on behalf of the party on the continuance of whose life that payment or those payments depend, then it is evident, that the effecting of an assurance, or the purchase of any other benefit for which an annual premium is to be paid, is nothing more than an exchange, or *commutation* of one benefit for another depending on the same life. Consequently, that the transaction may be equitable, there must be an equality between the present values of the two benefits; or, restricting this term to its legitimate signification, between the present value of the premium and that of the benefit in exchange for which it is to be given. Therefore, if we form an equation between the expressions for the present values of the premium and the benefit, using a symbol for the unknown amount of the former, we are furnished, by the solution of this

* Mr. Davies' work having been long out of print, we have not been able to procure even a sight of it. But we have no reason to believe that it contains anything akin to the contrivance we have referred to. With the other works noticed on page 425, as treating on the use of the Commutation Tables, we possess a competent acquaintance; and certainly in none of them is the least trace of this contrivance to be found.

equation, (which is in all cases an exceedingly simple operation,) with a value of the symbol employed, which value is that of which we are in quest. It is in the idea of forming this equation that Professor De Morgan's contrivance consists; and it will be seen how efficiently it serves the intended purpose.

It now only remains for us to illustrate these observations by a few examples, after premising two or three explanatory remarks.

1. In forming the equation just referred to, it is advisable, for the sake of generalization, to use a symbol also to denote the amount of the benefit. Those explained in last paper will be employed for this purpose; and $\pi$ will be employed to denote the amount of a uniform premium, and the first payment of a variable premium.

2. Since a premium, as regards its present value, differs from an annuity for the same number of years, only in making its first payment a year earlier, the expression for that value is found, according to the principles laid down in Problems II., III., and IV., by writing $x-1$ for $x$ in the expression for the present value of the corresponding annuity, using of course $\pi$ instead of $a$ to denote the amount. Thus, the expression for the present value of a uniform life premium of £$\pi$, is $\pi\,\mathrm{N}\,(x-1)$; and that for a variable premium, also for life, of £$(\pi \pm \beta)$, £$(\pi \pm 2\beta)$, &c., is $\pi\,\mathrm{N}\,(x-1) \pm \beta\,\mathrm{S}\,(x)$. Also, for the same premiums to last $n$ years, the expressions will be,

$$\pi\,[\mathrm{N}(x-1) - \mathrm{N}\,(x+n-1)],$$

$$\text{and } \pi\,[\mathrm{N}\,(x-1) - \mathrm{N}\,(x+n-1)] \pm \beta\,[\mathrm{S}\,(x) - \mathrm{S}\,(x+n) - n\,\mathrm{N}\,(x+n-1)].$$

3. If we use $\sigma$ to denote a sum to be paid now, that is, present value of any kind, then, to subject it to the same denominator as the other expressions for present values, viz., $\mathrm{D}\,(x)$, we must write it thus, $\sigma\,\mathrm{D}\,(x)$. All the expressions for present values, as we require to use them in this application of the tables, will now be affected by the same denominator, $\mathrm{D}\,(x)$; and since, in forming an equation between any two of these expressions, this constant denominator must necessarily disappear in the solution, we have obviously no farther occasion for it, and it will therefore never be exhibited. To avoid the anomaly, however, of longer calling the expressions from which the denominator is abstracted present values, they will be called the benefit side and the payment side of the equation.

Example 1.—Required the present value of a life assurance of £A on $(x)$.

Here the benefit side of the equation is, by (XI.), $\mathrm{AM}\,(x)$, and the payment side is, as above, $\sigma\mathrm{D}\,(x)$.

$$\therefore\ \sigma\mathrm{D}\,(x) = \mathrm{AM}\,(x);\ \text{and } \sigma = \frac{\mathrm{AM}\,(x)}{\mathrm{D}\,(x)},$$

as was before found.

Example 2.—Required $\pi$, the annual premium for a life assurance of £A on $(x)$.

The benefit side is, as in last example, $\mathrm{AM}\,(x)$, and the payment side, by (II.), $\pi\mathrm{N}\,(x-1)$.

$$\therefore\ \pi\mathrm{N}\,(x-1) = \mathrm{AM}\,(x);\ \text{and } \pi = \frac{\mathrm{AM}\,(x)}{\mathrm{N}\,(x-1)}.$$

If A = £100, and $x = 30$, we have,

$$\pi = \frac{100\mathrm{M}\,(30)}{\mathrm{N}\,(29)} = \frac{74295{\cdot}67}{39382{\cdot}08} = 1{\cdot}8866 = £1\ 17s.\ 9d.$$

Example 3.—An endowment of £$s$, to be received in $n$ years, provided $(x)$ be then alive, is to be paid for by an annual premium, $\pi$, to last $l$ years. Required $\pi$.

Here the benefit side is, by (I.), $s\mathrm{D}\,(x+n)$, and the payment side is, by (IV.), $\pi\,[\mathrm{N}\,(x-1) - \mathrm{N}\,(x+l-1)]$.

$$\therefore\ \pi\,[\mathrm{N}\,(x-1) - \mathrm{N}\,(x+l-1)] = s\mathrm{D}\,(x+n);$$

$$\text{whence, } \pi = \frac{s\,\mathrm{D}\,(x+n)}{\mathrm{N}\,(x-1) - \mathrm{N}\,(x+l-1)}.$$

If $s$ = £100, $x = 23$, $n = 20$, and $l = 10$, we have,

$$\pi = \frac{100\,\mathrm{D}\,(43)}{\mathrm{N}\,(22) - \mathrm{N}\,(32)} = \frac{114562{\cdot}6}{58976{\cdot}5 - 32946{\cdot}10} = \frac{114562{\cdot}6}{26030{\cdot}05} = 4{\cdot}4012 = £4\ 8s.\ ^{*}$$

* This is the problem proposed by Iver Mac Iver, at page 95 of the present volume, and solved by Mr. Scott and the writer, at pp. 114, 115.

If the premium be payable till the endowment become due, we have only in the formula to substitute $n$ for $l$; and, to apply it to the particular case just solved, we have,

$$\pi=\frac{100\,D(43)}{N(22)-N(42)}=\frac{114562{\cdot}57}{58976{\cdot}15-17483{\cdot}64}=\frac{114562{\cdot}57}{41492{\cdot}51}=2{\cdot}7610=£2\ 15s.\ 3d.;$$

a smaller premium, since, commencing at the same time, it continues longer.

Example 4.—£A, to be received $n$ years hence, if $(x)$ be then alive, or at the end of the year of death, if that event take place before the expiry of $n$ years, is to be paid for by an annual premium, $\pi$, to continue until the receipt of the benefit is determined. Required $\pi$.

Here the benefit side is, by (I.), and (XIII.), $A[D(x+n)+M(x)-M(x+n)]$; and the payment side is, by (IV.), $\pi[N(x-1)-N(x+n-1)]$.

$$\therefore\ \pi[N(x-1)-N(x+n-1)]=A[D(x+n)+M(x)-M(x+n)].$$

$$\text{Whence, }\pi=\frac{A[D(x+n)+M(x)-M(x+n)]}{N(x-1)-N(x+n-1)}.$$

If $A=£100$, $x=30$, and $n=30$; that is, if the benefit be receivable at 60, or at death, if before 60, we have,

$$\pi=\frac{100[D(60)+M(30)-M(60)]}{N(29)-N(59)}=\frac{41857{\cdot}53+74295{\cdot}67-24598{\cdot}20}{39382{\cdot}08-4487{\cdot}42}=\frac{91555{\cdot}00}{34894{\cdot}66}=$$

$$2{\cdot}6238=£2\ 12s.\ 6d.$$

Example 5. — Required the annual premium, $\pi$, payable till death, for an assurance of £A, on $(x)$, with which the whole of the premiums paid are to be returned.

Here, the sum to be received if death take place in the first year is $A+\pi$, if in the second, $A+2\pi$, and so on. Therefore, the benefit side is, by (XIX.),

$$(A+\pi)M(x)+\pi R(x+1)=AM(x)+\pi R(x),\text{ by (10)};$$

and the payment side is, by (II.), $\pi N(x-1)$.

$$\therefore\ \pi N(x-1)=AM(x)+\pi R(x);\text{ whence we obtain,}$$

$$\pi=\frac{AM(x)}{N(x-1)-R(x)}.$$

If $A=£100$, and $x=30$, we have,

$$\pi=\frac{100M(30)}{N(29)-R(30)}=\frac{74295{\cdot}67}{39382{\cdot}08-17127{\cdot}42}=\frac{74295{\cdot}67}{22254{\cdot}65}=3{\cdot}3388=£3\ 6s.\ 8d.^*$$

Example 6.—An assurance of £A, for $n$ years, on $(x)$, is to be paid for by an annual premium, $\pi$, also to last $n$ years. Required $\pi$.

Here the benefit side is, by (XIII.), $A[M(x)-M(x+n)]$, and the payment side, by (IV.), $\pi[N(x-1)-N(x+n-1)]$.

$$\therefore\ \pi[N(x-1)-N(x+n-1)]=A[M(x)-M(x+n)];$$

$$\text{Whence, }\pi=\frac{A[M(x)-M(x+n)]}{N(x-1)-N(x+n-1)}.$$

This expression assumes a very convenient form, if, instead of column M, we use its value in terms of N. Thus, since, by (13),

$M(x)=vN(x-1)-N(x)$, and $M(x+n)=vN(x+n-1)-N(x+n)$, we have,

$$\pi=\frac{A\{v[N(x-1)-N(x+n-1)]-N(x)+N(x+n)\}}{N(x-1)-N(x+n-1)}$$

---

* The Commutation Table, as it stands, does not enable us, conveniently, to find the amount of annual premium equivalent to a benefit which consists partly of a return of all the premiums paid, with simple interest upon them from the date of payment, the incremental portion being in this case of the form $m$, $3m$, $6m$, $10m$, &c. The addition of another column, formed from R as R is formed from M, would however afford the means of doing so. We might obviously add as many columns as we pleased in this way. Their properties would be such that, calling the column formed from R the *first*, the division of any number in the $n$th column, by the corresponding number in D, would give the present value of an assurance whose payments should be the series of figurate numbers of the $n$th order; and the remark may be extended, *mutatis mutandis*, to the annuity columns. But such properties being more curious than useful, we do not insist upon them.—See De Morgan, I., p. 23.

$$=A\left\{v-\frac{N(x)-N(x+n)}{N(x-1)-N(x+n-1)}\right\}.$$

If $A=£100$, $x=30$, and $n=10$, the solution by the first of these formulæ will be,

$$\pi=\frac{100[M(30)-M(40)]}{N(29)-N(39)}=\frac{100(742\cdot9567-522\cdot6503)}{39382\cdot08-21306\cdot62}=\frac{23030\cdot64}{18075\cdot46}=$$
$$1\cdot2188=£1\ 4s.\ 5d.$$

The solution by the second formula will be,

$$\pi=100\left\{v-\frac{N(30)-N(40)}{N(29)-N(39)}\right\}=100(\cdot961539-\frac{17159\cdot95}{18075\cdot46})=$$
$$100(\cdot961539-\cdot949351)=1\cdot2188, \text{ as before.}$$

Example 7.—An annuity of $£a$, deferred for $n$ years, on $(x)$, is to be paid for by a uniformly decreasing annual premium, to be extinguished when the annuity is entered upon. Required $\pi$, the first year's premium.

Here the benefit side is, by (III.), $aN(x+n)$; and, since the premium is to be extinguished in $n$ years, it will make $n+1$ payments. In order, therefore, that the $(n+2)$th payment, which would be due when the first payment of the annuity is receivable, may be 0, the annual decrease must be $\frac{\pi}{n+1}$. The payment side consequently is, by [20,6],

$$\pi\left\{N(x-1)-\frac{1}{n+1}[S(x)-S(x+n+1)]\right\}.$$

Hence, $$\pi\left\{N(x-1)-\frac{1}{n+1}[S(x)-S(x+n+1)]\right\}=aN(x+n);$$

$$\therefore\ \pi=\frac{aN(x+n)}{N(x-1)-\frac{1}{n+1}[S(x)-S(x+n+1)]}.$$

If $a=£100$, $x=40$, and $n=20$, we have,

$$\pi=\frac{100N(60)}{N(39)-[S(40)-S(61)]\div21}=\frac{406884\cdot83}{21306\cdot62-(252533\cdot78-29648\cdot60)\div21}=$$
$$\frac{406884\cdot83}{21306\cdot62-10613\cdot06}=\frac{406884\cdot83}{10693\cdot56}=38\cdot0495=£38\ 1s.$$

Example 8.—An increasing life assurance of $£A$, $£(A+H)$, $£(A+2H)$, &c., on $(x)$, is to be paid for by a premium which is to be $\pi$ for the first $n$ years, $\frac{2}{3}\pi$ for the next $n$ years, and $\frac{1}{3}\pi$ for the remainder of life. Required $\pi$.

The benefit side is, by (XIX.), $AM(x)+HR(x+1)$; and the payment side is,

for the first $n$ years, $\pi[N(x-1)-N(x+n-1)]$;
second $\frac{2}{3}\pi[N(x+n-1)-N(x+2n-1)]$;
remainder of life $\frac{1}{3}\pi N(x+2n-1)$.

Therefore, adding these for the whole payment side, we have,

$$\pi\{N(x-1)-\tfrac{1}{3}[N(x+n-1)+N(x+2n-1)]\}=AM(x)+HR(x+1);$$

$$\therefore\ \pi=\frac{AM(x)+HR(x+1)}{N(x-1)-\frac{1}{3}[N(x+n-1)+N(x+2n-1)]}.$$

If $A=£100$, $H=£5$, $x=30$, and $n=7$, the formula becomes,

$$\pi=\frac{100M(30)+5R(31)}{N(29)-\frac{1}{3}[N(36)+N(43)]}.$$

And, taking the numbers from the table, we should find,

$$\pi=6\cdot1644=£6\ 3s.\ 3d.$$

This mode of paying premium, although not unusual in practice, is not included in Professor De Morgan's general Problem (I., pp. 10, 11). We subjoin the general expression for the payment side of the equation when a benefit is to be paid for in this manner, that is, by a premium remaining constant

during one or more terms of years, but varying, either by increase or decrease at the end of each term. Let $p$, $q$, and $r$, denote any numbers whatever, either whole or fractional; also, let $l$, $m$, and $n$, denote any terms of years, whatever: then the payment side of the equation, for a premium which is to be $\pi$ during the first $l$ years, $p\pi$ during the following $m$ years, $q\pi$ during the following $n$ years, and $r\pi$ for the remainder of life, will be,

$$\pi[N(x-1)+(p-1)N(x+l-1)+(q-p)N(x+l+m-1)+(r-q)N(x+l+m+n-1)].$$

From this expression it appears, that, if $p$ be less than unity, $q$ less than $p$, and $r$ less than $q$, the premium will decrease at the end of each term, and *vice versa*. To apply this expression to the last example, let $x=30$, $p=\frac{7}{8}$, $r=\frac{1}{8}$, $l=m=7$; and, since there are only two *definite* periods, during which the payments are uniform, $n=0$ and $q=0$. Hence, the expression becomes,

$$\pi[N(29)-\tfrac{1}{8}N(36)-\tfrac{7}{8}N(43)+\tfrac{1}{8}N(43)]=\pi\{N(29)-\tfrac{1}{8}[N(36)+N(43)]\}.$$

Example 9.—A life assurance of £A on $(x)$ is to be paid for by a sum in hand, $\sigma$, and an annual premium, $\pi$. Required $\pi$.

Here the benefit side is $AM(x)$, and the payment side is $\sigma D(x)+\pi N(x-1)$.

$$\therefore\ \sigma D(x)+\pi N(x-1)=AM(x).$$

Whence, $\pi=\dfrac{AM(x)-\sigma D(x)}{N(x-1)}$.

If $A=$£1000, $x=40$, and $\sigma=$£100, we should find,

$$\pi=18\cdot2308=\text{£}18\ 4s.\ 7d.$$

Example 10. A person now aged $x$ years effected an assurance on his life, of £A, $n$ years ago, at an annual premium of £$\pi$, of which a payment is just due. He now wishes to dispose of his interest in the same, the purchaser to take on himself the payment of the future premiums, and to receive the sum assured, when it becomes due by the death of $(x)$. Required $\sigma$, the sum to be paid to $(x)$ for his interest in the policy.

The sum to be paid to $(x)$, that is, the present value of the policy, is evidently the difference between the present value of the assurance and that of the future premiums.

$$\therefore\ \sigma D(x)=A\,M(x)-\pi\,N(x-1);$$

Whence, $\sigma=\dfrac{A\,M(x)-\pi\,N(x-1)}{D(x)}$.

If $A=$£100, and $x=40$, then, if the assurance was effected ten years ago, and the premium calculated by the same table as is made use of for the valuation of the policy,* we should have,

$\pi=\dfrac{A\,M(30)}{N(29)}=1\cdot8864$. Hence, we find, $\sigma=8\cdot9926=$ £8 19$s$. 10$d$.

* This is by no means necessarily the case. The *actual* premium must always be used.

Here we must stop. The object of the writer in commencing the present series of papers was, as stated in the outset, to furnish an easy introduction to the papers on the same subject by Professor De Morgan, in the *Companion to the Almanack*; as he had found, in the course of his experience, that persons even who had paid some attention to the subject, were at a loss to comprehend the scope of the papers alluded to. Whether or not he has in any degree succeeded in his object is for those to say who may have honoured his lucubrations with an attentive perusal. He is himself sensible of many deficiencies in them, some of which, perhaps, if the opportunity were afforded him, he might be able to amend. Such as they are, however, they are now before the public; and he trusts that, as the work of an amateur, they will be viewed with indulgence. In particular, he has to bespeak the forbearance of the learned individual, in a desire to render whose writings on the subject more accessible than heretofore, they have originated. It is only now, in taking leave of the subject, that he perceives, in its full force, the presumption of which he fears he has been guilty. But as he thinks it may be allowed that his object has been praiseworthy, he trusts this will be received as an atonement for deficiencies in other respects. In the preparation of the articles the writer has made free use of Professor De Morgan's papers, as indeed he could hardly fail to do, since to them and to Mr. Jones's work he owes all the information he possesses on the subject. Notwithstanding this, however, and the circumstance that his papers considerably exceed in length those of the learned Professor, the vein from which the materials have been taken is not nearly ex-

hausted. It will still amply repay a search on the part of those whom interest or inclination leads to cultivate this branch of science.

G.

Hermes street, Pentonville, Dec. 6, 1842.

*Erratum.*—Page 458, column first, lines 4 and 5 from bottom, *dele*, "or $n$ into $k+n$." The writer is not aware of any other error affecting any of the formulæ; nor has he found an error in the Table as printed.

## PADDLE-WHEELS.

Sir,—From Mr. Zander's reply to my observations on paddle-wheels, any one would suppose I had imagined, that not only the *immersed floats*, but the whole of the floats in the wheel ought to be considered "*effective paddle-board surface;*" whereas, the whole of my remarks were intended to prove that, *not even so much as* the *total* area of the *floats immersed*, ought to be considered. I feel assured that Mr. Zander has not intentionally so misrepresented me, especially as I observe his letter is of an earlier date than the appearance in the Magazine of my second letter on the subject.

My remarks were called forth from facts I have myself observed in numerous experiments made upon paddle-wheels; but these were made with wheels having oblique floats, and partially enclosed at the sides, as already described in your Journal. With wheels of this construction, and immersed the depth which I have recommended, I have found that six floats are fully as effective as eight or any greater number, and therefore, conclude that in the common paddle-wheel, the total effective area of resistance at any one time cannot exceed the length of one paddle-board multiplied by *a, b,* (see page 422) the depth of immersion.

Tredgold (The Steam-Engine, Art. 635, 1827 ed.) observes: "The best position for paddles appears to be in a plane passing through the axis; if they be in a plane which does not coincide with the axis, they must either strike more obliquely on the fluid on entering, or lift a considerable quantity on quitting it." This condition is complied with in my improved paddle, by every point of the float radiating in a line from the extremity to the axis. Again, in the same article, he observes: "To set the paddle at any other than a right angle must obviously be a defect; for the resistance to motion becomes less when the surface strikes the water obliquely, whereas, the greater this resistance the greater the effect in impelling the vessel." This (otherwise) defect in my wheel is completely obviated by the side plates, which secure a resisting surface of the whole breadth of the wheel at the point of action.

I agree with Mr. Zander, that there is much to be done before we can arrive at a correct theory of the action of steam vessel propellers, especially as to the proper proportion of the propeller to the vessel; upon which very much must certainly depend.

I am, Sir, your obedient servant,

BENJ. BIRAM.

Wentworth, Dec. 3, 1842.

## MORTALITY IN THE METROPOLIS, AND IN THE COUNTRY DISTRICTS, ILLUSTRATED.

Sir,—An "*augmented mortality in the metropolis*" having been recently asserted in your pages, for party purposes, to which I gave an off-hand denial at page 397; I now avail myself of the publication of the "Quarterly Table of the Mortality in 114 of the principal districts of England and Wales," to show the utter falsehood of ascribing an *augmented* mortality to the metropolis.

| | | |
|---|---|---|
| The total number of deaths registered in the metropolis during the quarter ending Sept. 30th, out of a population of . . . | 1,870,727 was | 11,019 |
| In the remaining districts, out of a population of . . . . | 4,663,808 was | 28,050 |
| Making the total number of deaths, in a population of . . . | 6,534,535 | 39,069 |

As compared with the average number of deaths in the same quarter of the four previous years, there is an increase of 2474 deaths. The average for those years having been 36,595. This, however, includes the metropolis, whose

number of deaths was 2 *less* than the average of the four previous years; so that the whole of the *increase* has taken place in the *country* districts. The increase of population should, however, be taken into account, as reducing the proportionate increase of deaths in the country, and also in still farther reducing the *diminution* in the mortality of the *metropolis*. The population increases in the town districts about 1·74 annually which would reduce the average of deaths, applicable to the summer quarter of 1842, from 39,069 to 38,208, or 861 deaths less than those actually recorded. But this would still leave an increase upon the quarter of 1,613. In fact, the mortality was 2 per cent. greater than the summer average, which is at the rate of 23 deaths annually in a population of 1,000. In the last summer quarter, the mortality was at the rate of 23·4 annually in 1,000, viz., 23·0 in the *metropolitan* districts, and 23·6 in the provincial towns.

The following table shows the principal places in which (in some cases a very remarkable) increase has taken place.

| Towns. | Average of four previous years. | Increase. | Total No. of deaths last quarter. |
|---|---|---|---|
| Brighton ......... | 240 | 70 | 310 |
| Cheltenham ........ | 180 | 79 | 259 |
| Clifton.. .......... | 311 | 115 | 426 |
| Chorlton .......... | 465 | 214 | 679 |
| Dudley............ | 421 | 147 | 568 |
| Kidderminster .... | 109 | 63 | 172 |
| Leeds ............ | 1019 | 114 | 1133 |
| Liverpool......... | 1798 | 158 | 1956 |
| Manchester ....... | 1423 | 191 | 1614 |
| Nottingham ...... | 350 | 79 | 429 |
| Penzance ......... | 199 | 84 | 283 |
| Plymouth ....... | 165 | 178 | 343 |
| Preston .......... | 409 | 73 | 482 |
| Redruth .......... | 201 | 77 | 288 |
| Tynemouth ........ | 280 | 80 | 360 |
| Walsall ......... | 152 | 91 | 243 |
| Wolverhampton .... | 421 | 87 | 508 |

I think it probable, Mr. Editor, that very few of us are fully sensible of the immense obligations we owe to the progress of *statistical science*, which, by placing before us extensive and authentic series of facts, enables us at once to put down the charlatan and the empiric, who would otherwise each palm upon us such suggestions or mis-statements as were best calculated to serve his particular purpose—to give colour and plausibility to every scheme, however visionary—to puff off every nostrum, however mischievous.

Let us hope that it will be long before your pages are again made the vehicle for disseminating any thing so utterly at variance with truth, as the assertion that the impurity of the water supply has given rise to an "augmented mortality in the metropolis!"

I remain, Sir, yours respectfully,

WM. BADDELEY.

29, Alfred-street, Islington.
November 19, 1842.

## RAILWAY ECONOMY—THE SATELLITE LOCOMOTIVE.

Now that the miscalculation, blundering, and extravagance, by which the first cost of most of the railways of this country has been so enormously enhanced, are evils past, and gone, and remediless; and that the chief thing which share-

holders have to look to for good dividends—in some cases, indeed, the *only thing*—is economy in working the costly monopolies they have secured to themselves,—every fact bearing on this point is deserving of the most serious attention. We have reason to believe that there is yet a great deal to be done in this way; that is to say, if railway proprietors, warned by the past, will only be true to themselves, and look after their own. What, for example, can be more inexcusable, or more easy of remedy, than that the cost of engine power should on one line be double what it is, under the same, or nearly the same, circumstances, on another? Or that, on the same line, the consumption of some engines should be twice that of others? Why should not the engines of every line be worked at the least possible cost, and none but the most cheaply worked engines be in every case employed? The replacing of old engines by new may require an investment of additional capital not always at the command of railway companies; but wherever no insuperable obstacle of this sort exists, a proprietary cannot consult their permanent interests more surely than by getting rid of the wasteful gluttons of their engine establishment as speedily as possible. The savings of two or three years would, in most cases, more than suffice to replace all the capital required.

We have been led to make these remarks by what an engineering friend of ours witnessed the other day, in the course of a professional visit to the Brighton line. He went down with one engine, and came up with another, by different makers. The first was stated to be of the ordinary sort, and exhibited nothing in its performance which would lead one to doubt the correctness of the statement. The second was represented as being the crack engine of the line, and is called the *Satellite*. She drew a well filled train of nine carriages, the gross load, including engine and tender, being about 75 tons; and on the heavy parts of the line from Brighton to the first summit, where the rise is about 20 feet per mile, or 1 in 264, she went steadily, and without any apparent straining, at the rate of 30 miles an hour. Our informant was told that, on other occasions, the engine had dragged no less than seventeen carriages over the inclined planes, at the rate of 28 miles an hour, and that in more than one instance she had gone from London to Brighton at the rate of nearly a mile a minute, for the whole distance. It is now nearly a year since the *Satellite* came into active service (23rd of December, 1841), and since that period she has gone nearly 30,000 miles without requiring any repairs whatever—going off duty, in her turn, one week in six, but merely for the purpose of overhauling and cleaning. Nor is the economy with which the engine is worked less remarkable than her power and speed. Her average consumption of fuel is only 20 lb. of coke per mile, with a train of eight or nine carriages (the average number), or about a quarter of a pound per ton per mile. Every person familiar with railway statistics knows that such rates of performances and of expenditure are exceedingly rare, if, indeed, they have been ever before equalled, for so long a continuance. The average consumption of fuel upon railways cannot be taken at less than 40 lbs. per train, per mile; for, although some of the engines of the best makers consume considerably less, there are many which require a great deal more. On this very Brighton line, for example, it appears, from the enquiries which our informant made, that the consumption of the *Satellite* is less by one half than that of any of the other engines employed upon it.

The questions, then, which naturally arise out of this state of facts are these—Why is the *Satellite* the only engine of the sort employed on the Brighton line? and why are there not engines as good as the *Satellite* on all the other lines? Is a saving of 100 per cent. in the fuel account—equal, probably, to about 500*l.* per engine per annum—a thing not worth caring about?

The superiority of the *Satellite*, we understand, is not owing so much to any peculiarity or novelty of construction, as to the judicious arrangement of ordinary forms of construction, and to the excellent style of workmanship, in which the whole has been turned out from the workshops of the Messrs. Rennie, by whom she was built. The centre of gravity is placed low, and the back pressure is much less than usual. "I never," says our informant, himself a railway engineer of extensive experience, "have yet seen so well finished a locomotive

engine, or one so well proportioned, and with the parts exposed to strain so admirably strengthened and disposed; nor did I ever ride on one so extremely steady at all rates of speed, from the lowest to the highest."

## PROGRESS OF THE SCREW SYSTEM OF PROPELLING IN AMERICA.

We mentioned not long ago, (p. 181 of our present volume) that Capt. Ericsson was prosecuting with great success in the United States the adoption of the Screw Propeller, which he first brought out and patented in this country; but *the extent* of that success proves to be much greater than we then supposed. We stated that the number of vessels to which it had been applied was *eight:* but it appears from documents which have been submitted to our inspection, that the actual number is *thirteen,* including a government steamer of the first class. The vessels are:—

The ROBERT STOCKTON, tug boat, 70 feet long, 10 ft. beam, and 8 ft. hold, employed on the Delaware and Schuylkill.

The CLARION, 250 tons, wrecked on the coast of Florida.

The VANDALIA, CHICAGO, OSWEGO, } 90 feet long, 21 ft. 6 inch beam, and 8 feet hold. Employed on the Lakes.

VULCAN, IRONSIDES, ANTHRACITE, BLACKDIAMOND, } 100 ft. long, 23 ft. beam, and 7 ft. hold. River Delaware, Raritan Canal, &c.

PROPELLER, the St. Lawrence and Rideau Canal.

ERICSSON, { 100 ft. long, 18 ft. 6 inches beam, 6 ft. draught, Philadelphia & Baltimore station

PRINCETON, Government steamer, 680 tons, building at Philadelphia.

———— iron vessel not yet named, of 80 ft. long, 14 ft. 4 inches beam, and 6 ft. hold, building by the Messrs. Worthington of New York.

Arrangements are also stated to have been made (October 1842,) for building two more vessels similar to the *Ericsson,* which are to be placed "next spring" on the same station.

The engines of the *Princeton* Government steamer, as well as the screw propeller, have been constructed from designs furnished by Capt. Ericsson, and under his immediate superintendence; and in a letter which we have now before us from the makers, Messrs. Merrich and Towne of the Southwach Foundry, they are thus described:

"The engines consist of two semi-cylinders laid side by side; the piston shafts lay horizontal, and upon them is fixed a piston or leaf, which is to vibrate 90 degrees. The semi-cylinders are 8 feet long and 3 feet radius. The main shaft passes under and between the semi-cylinder, through a stuffing box in the dead wood of the ship. The propeller is fixed on the end of the shaft in a space left between the dead wood and the stern post. The two piston shafts have fixed on their outward extremity each a crank which vibrates with the piston, and are connected by a pitman with the crank of the main shaft. The centres of the three cranks form a triangle.

"These engines are nearly finished, and are now being put together for inspection in our establishment.

"The vessel has been delayed from circumstances beyond Captain Ericsson's control, but it is expected that she will be ready to launch in the early part of next summer."

A letter, or rather certificate, dated the 27th of October last, by Mr. Peter Hogg, of the firm of Messrs. Hogg and Delamater, steam-engine manufacturers of New York, furnishes the following additional particulars respecting the boilers of the *Princeton* and her propellers.

"The boilers lately manufactured by the said firm for the steam frigate *Princeton,* are three in number, each of 26 feet in length, 7 feet wide, and 9 feet 6 inches in height. Agreeable to a contract made with the United States Government, the firm are also manufacturing the propeller for the said steam frigate according to Capt Ericsson's drawings, and under his direction, which said propeller is made entirely of composition metal, (nine parts of copper to one of tin,) and measures 14 feet in diameter."

Messrs. Merrich and Towne make some observations in their letter respecting the peculiar application of stern propellers to coast and canal navigation, which are also well worth quoting.

"The success of this vessel (the *Ericsson*) and four iron vessels, built by Capt. Stockton last spring, with the propellers, has satisfied us, and many well-informed parties, that the introduction of the "Ericsson Propeller" will in a short period completely revolutionize our coast trade, by the introduction of steam instead of sails.

"The peculiar formation of the coast, being filled with deep indentations connected

with short canals of large dimensions at intervals precluded the use of the paddle-wheel for the freighting business; but the introduction of the propeller places the whole trade under the control of steam."

## MOSELEY'S MECHANICAL PRINCIPLES OF ENGINEERING AND ARCHITECTURE.—THIRD NOTICE.

The attention of the student is next directed to the "Strength of the Materials" of which machines and buildings are composed.

The "elasticity" of bodies is shown to depend on this law, that "the force necessary to keep a body extended or compressed is proportional to the amount of the extension or compression; so that each equal increment of the extending or compressing force produces an equal increment of its extension or compression." From an extensive series of experiments made by Mr. Barlow, on iron bars of different qualities, he deduced the conclusion, that a bar of iron of mean quality may be assumed to elongate by 100 millionth parts, or the 10,000th part of its whole length, under every additional strain of one ton per square inch of its section. The French engineers of the Pont des Invalides assign 82 millionth parts to this elongation; but Professor Moseley thinks it probable that these experiments were made upon iron of an inferior quality. Cables of iron wire elongate, according to Vicat, by 91 millionth parts; and bars of oak, according to Minard and Desormes, by 1,176 millionth parts. The strain, however, in all these cases, is supposed to be applied by equal increments; for it is further established, that if the whole strain, corresponding to any particular degree of elongation, be put on at once, *twice* as much *work* will be done upon the bar as is expended on its elasticity. Of this Mr. Moseley gives the following striking illustration, to which we would beg to invite the particular attention of all concerned in the working of steam-engines.

"The mechanical principle involved in this result has numerous applications; one of these is, to the effect of a sudden variation of the pressure on a mercurial column. The pressure of such a column varying directly with its elevation or depression, follows the same law as the elasticity of a bar; whence it follows, that if any pressure be thrown *at once*, or instantaneously, upon the surface of the mercury, the variation of the height of the column will be twice that which it would receive from an equal pressure gradually accumulated. Some singular errors appear to have resulted from a neglect of this principle in the discussion of experiments upon the pressure of steam, made with the mercurial column. No such pressure can, of course, be made to operate, in the mathematical sense of the term, *instantaneously*; and the term *gradually* has a relative meaning. All that is meant is, that a certain relation must obtain between the rate of the increase of the pressure and the amplitude of the motion; so that, when the pressure no longer increases, the motion may cease."—Page 490.

The general rule laid down by the Professor is, that *the work* expended on the elongation of a bar should vary only as the square of the strain and the length of the bar, and inversely as the area of its section; and, by applying this rule, the engineer may always determine the amount of work expended *prejudicially* upon the elasticity of the rods used for transmitting work in machinery under a reciprocating motion—pump-rods, for instance. A *sudden* effort of the pressure transmitted in the nature of an impact may make the expenditure of work double that which the above rule shows to be necessary.

In treating of *rupture* by elongation, Mr. Moseley is led to a discussion of the theory of Suspension Bridges. As these structures have been hitherto commonly designed, the chains have had *one uniform section*. The author demonstrates that this is "false in principle;" and that, if it is required to build a bridge of "*uniform strength*," and therefore with "*the greatest economy of material*," the area of the section of the chains should "increase from the lowest point towards the points of suspension where it is greatest." The readers of our work will instantly recognize, in this important conclusion, the distinguishing principle of the suspension bridge invented by Mr. Dredge, which we have so often had occasion to bring under their notice; and will, doubt-

less, be as much surprised as we have been, (a surprise, on our parts, not unmixed with sorrow,) to read the following note, which Mr. Moseley has appended to his enunciation of the new principle.

"This variation of the section of the chains is exhibited in a suspension bridge recently invented by Mr. Dredge, *and appears to constitute the whole merit of that invention.*"—Page 543.

The tone of this note is palpably slighting and disparaging; and, exactly to the extent which it is so, is most unjust. True, Mr. Dredge did but discover that the section of the chain should diminish from the highest to the lowest point; but, in discovering that, he discovered all that is confessedly of most importance in the erection of structures of this class. He discovered this principle, too, before any thing similar had been evolved, either by the practice of engineers or by the cogitations of mathematicians. What one of the first of engineers, Telford, missed, in the greatest of all his works, a person wholly unknown before to the engineering world has had the good fortune to find; what all the profound learning of the Whewells and the Powells of the schools, had failed to bring to light, has been revealed to the world through the humble medium of the self-taught experimenter of Bath. It may be that the happy thought came to him, not through a long vista of mathematical symbols, (as, in truth, but few happy thoughts come,) but simply from contemplating the taper form of his fishing-rod; but surely it is not for a follower of the illustrious observer of the fall of the apple to sneer at Mr. Dredge on that account. Mr. Moseley does not fail to point out in his Preface, (page xvi.,) the beautiful simplicity which the principle of the diminishing section has introduced, *for the first time*, into the theory of the suspension bridge; and common justice, if not gratitude, demanded at his hands a frank recognition, in the same conspicuous place, of the claims of its discoverer. We say *gratitude*, and repeat the word emphatically; because it is a curious fact, that, as long as engineers continued to make the chains of their suspension bridges with one uniform section, the mathematicians never discovered that there was any thing wrong in that practice, but, on the contrary, made it the foundation of all their theories on this subject—theories which, proceeding on false data, were, of course, good for nothing; and because, if Mr. Moseley has been able to produce a simpler and truer theory of the suspension bridge than any of his predecessors, it is entirely owing to the individual whom it is the tendency, if not the object, of the foot-note we have quoted to discredit and injure.

We gladly pass from the case of Mr. Dredge and the Suspension Bridge to another, in which, though strikingly and essentially alike in all its circumstances, Professor Moseley has seen fit to pursue a directly opposite course. We allude to that of Mr. Eaton Hodgkinson, and his experiments on the Strength of Columns. Here, as in the case of the Suspension Bridge, the "Mathematics and Mathematicians" were all at fault, till "Practice and Practicians" came to their aid. "The hypothesis," Mr. Moseley admits, "upon which it has been customary to found the theoretical discussion of the subject, is so obviously insufficient, and the results have been shown by Mr. Hodgkinson to be so little in accordance with those of practice, *that the high sanction it has received from labours such as those of Euler, Legrange, Poisson, and Navier, can no longer establish for it a claim to be admitted among the conclusions of science.*" Again—"for all the knowledge on this subject, *on which any reliance can be placed*, the engineer is indebted to experiment." And farther—"In treating of the strength of columns, I have gladly replaced the *mathematical speculations* upon this subject, which are *so obviously founded upon false data*, by the invaluable experimental results of Mr. E. Hodgkinson, detailed in his well-known paper in the Philosophical Transactions for 1840." For that paper the Royal Society, with excellent judgment, awarded to Mr. Hodgkinson the Royal Medal; and possibly it may be owing to that circumstance that Mr. Moseley sees a merit in the "Practician" Hodgkinson, which is so dimly

discernible to him in the clever, but unmedalled "Practician" Dredge.

While adverting to the services which practicians have rendered to science, we must not here omit to quote the very proper notice which Mr. Moseley takes of the share which another eminent individual of that class had in Mr. Hodgkinson's experiments.

"The experiments were made at the expense of Mr. Fairbairn, of Manchester, by whose liberal encouragement the researches of practical science have been in other respects so greatly advanced."—Page 578.

Let us now see which are the chief practical results for which we are indebted to Messrs. Hodgkinson and Fairbairn. Leaving out the mathematical formulæ in which the Professor has, (for his scholarship's sake, we suppose,) enveloped them, they are these:—

"In all cases the strength of a column, one of whose ends was rounded and the other flat, was found to be an arithmetic mean between the strength of two other columns of the same dimensions, one having both ends rounded, and the other having both ends flat.

"The above results apply only to the case in which the length of the column is so great, that its fracture is produced wholly by the *bending* of its material; this limit is fixed by Mr. Hodgkinson, in respect to columns of cast-iron, at about 15 times the diameter, when the extremities are rounded, and 30 times the diameter when they are flat. In shorter columns, fracture takes place partly by the crushing, and partly by the bending of the material. * * *

"It was found that the strength of columns of cast-iron, whose diameters were *from one-and-a-half times to twice as great in the middle as the extremities*, were stronger, by one-seventh, than solid columns containing the same quantity of iron, and of the same length, when the extremities were rounded; and stronger by one-eighth, or one-ninth, when the extremities were flat, and rendered immoveable by discs. * * *

"Calling the strength of the cast-iron column 1000, the strength of the wrought-iron column will, according to these experiments, be 1745; that of the cast-steel column, 2518; of the column of Dantzic oak, 108·8; and of the column of red deal, 78·5.

* * *

"It results from these experiments, that the strength of short columns of wet timber to resist crushing is not *one-half* that of columns of the same dimensions of dry timber."—Page 579.

(*To be concluded in our next.*)

## WOOD-PAVING.

Sir,—To arrive at truth, it is necessary to look at every side to a question; and if the letter of "Junius Redivivus" were left unanswered it might lead us from that desirable point. He states that in 1834 he gave three several reasons for doubting the success of wood-paving, founded on the assumption, that none but the hexagon block would be used; all which reasons have proved erroneous. How, indeed, should they prove otherwise? What can the swelling of blocks, or the rotting of blocks, or being stolen like farmers' fences, (the three reasons,) have to do with the shape of the blocks? He finds, after a lapse of eight years, there are good reasons why wood-paving should become general; and he is right in his conclusion, but not so in his views as to carrying out the improvement; and as every error in so important a question is calculated to do some harm, I will trouble you with a few observations.

The alleged drawback of the slipping of horses, has proved as fallacious as all other fears on this subject. It is a fact now rarely questioned, that horses used to wood can run as securely as on stones; nor will it be difficult to understand this, if we recollect our own awkardness, when for the first time trying to walk the ice on skates. Besides, the alteration in the construction of the shoes is at this moment keeping pace with the paving.

The swelling of the timber, stated by your correspondent to be an evil, is proved to be the very contrary. In the instance of St. Giles' Church, the primary evil was, that the patentee depended on the curb-stones for abutments, to form a sort of arch, leaving no room for swelling. Such disruption has never occurred in any other instance, nor will it ever occur again unless from a similar cause. I believe no one has more studied this subject than myself, and I can safely assert that London does not contain a yard of paving, on any principle, that has not been improved by the swelling in the working of the blocks to their final settlement and adjustments, in assisting to fill up and form a mass that can be obtained by no other means. In fact, it has proved a friend to wood-paving most desirable, and certainly most unexpected.

The principal error, however, of your correspondent consists in stating that the most approved plan now is with an angle of 45° to the horizon. It is a fact which

I thought every man was acquainted with, that we have not one yard in London at 45°, nor (except a few yards laid within the past month) any inclined block at any other than between 63° and 64°. Indeed, the only inclined blocks ever yet laid down are those on Parkin's patent, taken out Oct. 1839, and Count de Lilse's, about three months after. A pavement with an angle of 45° would present so much of the *side* of the fibre, that a horse could not stand on it any more than if the grain were parallel to the road; and every one that has trodden on a wet polished plank can form some idea of that.

The last error, is to suppose that grooving will diminish the wear to any material degree, especially when it is proved that good wood will wear but one third as fast as stone, (about half an inch in seven years.) This, however, can be the case only when a perfectly uniform and smooth surface is maintained; then there is no concussion, and pressure will make the wood harder.

I am, Sir, your subscriber,
T. H. B.

## READMAN'S BAROMETER.

Sir,—Your remarks upon my communication relative to barometers, inserted in the October Part of the *Mechanics' Magazine*, although not altogether strictly correct as to dates, were, nevertheless, sufficiently satisfactory as regarded their intended purpose. In the November Part of your Magazine, Mr. Readman, admitting the principle of suspending, or placing the cistern of a barometer on a spring or balance, to be the only point in which our inventions agree, claims the extension of this principle to the *weighing the mercury in the cistern*, which he considers to be a better test of atmospheric pressure, than that of estimating the length of the column of mercury within the tube.

In the present instance, I am not inclined to admit that any practical advantage can arise from Mr. Readman's substitution of weight for measure; for, unless the tube be so selected or prepared, that its bore shall be accurately cylindrical within the limits of the mercurial range, his method of weighing would be evidently imperfect; and, unless his cistern be constructed upon the principle which I have recommended for the constant self-adjustment of the surface of the mercury within the cistern to that within the tube, as indicated by the scale and vernier, no results can be obtained that will not require subsequent correction, even although the tube itself be an accurate cylinder.

If your scientific readers admit the truth of these statements, they may, of course, (provided my principle, so far as I have described it, be fully embodied in the barometers constructed by Mr. Readman,) resolve for themselves whether they would rather estimate the differences of atmospheric pressure *by weight*, as indicated by a steel-yard or other contrivance, or *by measure*, as shown by a well divided scale and vernier.

Believe me, very faithfully yours,
CHAS. THORNTON COATHUPE.

Wraxall, near Bristol, December 5, 1842.

## THE "MAGICIAN" OF THE THAMES.

A new iron steamer has been lately launched in the River, 'yclept the *Magician*, which, if all be true that is reported of her, has not been unfitly named. She has been built by Messrs. Ditchbourne and Mare, and engine-fitted by Messrs. Penn and Son. Her burthen is 360 tons, and her lines beautiful; her engines are of 110 horses' power. The paddle-wheels are on Morgan's feathering plan. A Woolwich correspondent, who supplies us with the preceding particulars, affirms that she goes "upwards of fifteen miles an hour;" and another 'longshoreman states, in confirmation of this surprising speed, that the *Magician* started from Woolwich an hour after a Government steamer of 320 horses' power, and within another hour overtook and passed her!

## MR. BAGGS'S CARBONIC ACID ENGINE.

Sir,—I am not aware if it has ever been suggested to Mr. Bagg, the ingenious inventor of the Carbonic Acid Engine, described in No. 1005 of your Magazine, to attempt its introduction on the common road, where I should imagine it would be more likely to be of importance than on a railroad, comparatively speaking, as obviating many of the (apparently) insuperable defects of a common road steam-carriage.

First, it would be of greatly less weight; secondly, not liable to so much damage from jolting; and, thirdly, not liable to a loss of power while stopping.

I am, Sir, &c.,

S. M.

## NOTES AND NOTICES.

*New Breakwater.*—The steamer *Monkey* recently arrived in this port, having in tow a cylinder of large dimensions, and freighted with heavy iron work, forming the material for a section of a floating breakwater, the invention of Captain Groves, late of the Rifle Brigade, which is to be moored experimentally in the bay. Judging from its appearance, there is nothing complicated or difficult in its construction. The whole is of iron. The cylinder sustains a grating, attached to it by hoops, and firmly braced by stays passing round the cylinder, and very securely bolted into the bottom of the grating. The draught of water will be about 12 feet, and it will be moored broadside to the sea, both to landward and seaward. Nautical men say that the doubtful part of the experiment is the ability of the moorings to resist the immense strain to which they will be subjected. Although this experiment is made with the sanction and under the auspices of Government, Captain Groves incurs the whole expense of the work, with the exception of the moorings, which were furnished from Sheerness Dockyard.—*Dover Telegraph.* The following notice of the actual mooring of this breakwater has since appeared in the London Papers. "Dover, Dec. 6. The experimental floating breakwater, constructed by Captain Groves, has been this day moored in Dover-bay, in 7 fathoms water. It is an iron cylinder, painted black, 50 feet long, 8 feet in diameter, and riding about 4 feet out of the water, nearly a-third of a mile from the pier, bearing E.S.E. from the light on the south pier. A spar, 20 feet high, with a red flag and a bell, will be attached to it."

*Method of Obtaining Copper and Silver in the most Minute State of Division.*—A solution of sulphate of copper is heated to the boiling-point, and precipitated with distilled zink. The precipitated copper is then separated from the adherent zink by diluted sulphuric acid, and dried by exposure to a moderate temperature. From recently precipitated chloride of silver an exceedingly fine silver-dust may also be obtained by boiling it with water acidulated with sulphuric acid and zink.—*Boettger's Beitrage.*

*Microscope Extraordinary.*—A new microscope, of astonishing magnifying power, has just been added to the admirable collection of instruments at the Polytechnic Institution. Its highest power magnifies an object 74,000,000 times. The wings of the locust, the flea, the house spider, the sting of a bee, &c., fill the whole field of view, being twenty-four feet diameter. The eye of the fly, containing 750 lenses, is distinctly shown, and appeared like a large patterned carpet, and the various animalculæ in water, &c., look like enormous land animals of the most grotesque shapes. The instrument was made by that eminent optician Mr. Carey.

*A Railway entirely of Iron.*—In consequence of the intended junction of the Liverpool and Manchester with the Leeds and Manchester Railway at Hunt's-bank, a distance of some 200 or 250 yards will have to be executed by the Bolton Railway Company. It will be formed entirely of cast-iron, and will be about eighteen feet above the level of the pavement; to effect which, fifty-one immense cast metal beams will be required, each weighing about seven tons, and a similar number of pillars, each weighing five tons. Besides this, the entire length and breadth of the road will have a complete cast metal flooring. The estimated weight of the whole is 1030 tons, exclusive of the weight of the wrought-iron and the rails. The railway will be formed in the centre of the street, leaving a carriage road on each side. The design is beautiful; and the work, judging from appearances, will be of the most substantial description.—*Mining Journal.*

*Prevention of Spontaneous Combustion.*—A letter has been received at Lloyd's, from Dr. William Bland, on the subject of spontaneous combustion of wool in ships. The principle of Dr. Bland's system of prevention is the manufacture of carbonic acid gas on board when required, which, by its specific gravity, would subside among the wool, displacing the atmospheric air. He states that 400 lbs. of carbonate of lime, as whitening, chalk, or the poorer marbles, yield about 180 lbs. of this gas, which would fill a space of 20,000 cubic feet, or 500 tons by measurement. The mode of application, he advises, is to place a cask in every hold, perforated two-thirds the height with a hole an inch in diameter, and lined with lead to that height. Into the head of each cask a metallic tube is to be placed, leading from the deck, and protected by a wood casing; each cask to be provided with the necessary quantity of the carbonate, and when required for use, pour down a requisite quantity of sulphuric acid, diluted with four or five times its weight of water, when the carbonic acid gas would disperse to every part of the hold.

*Electro-Carbonic Battery.*—Some months since, being engaged in experiments with Grove's flat-celled battery, some of the prominent defects of form, construction, and expense, seemed to me to be remediable by another mode of construction, and the use of a cheaper negative element. About the same time, I learned that Berzelius had, in a letter to Dr. Hare, given an account of a battery where coke was at once the negative element and the containing vessel for the nitric acid. I have since made many experiments, and now give the result, which seems most promising. Natural plumbago, or the mixture of it with sand, such as is used in the manufacture of crucibles, gives the form of carbon, which is at once the most effective, cheap, and manageable. A battery was constructed of six cylindrical members of native plumbago, each element one inch in diameter and two inches high, placed in nitric acid of the commercial strength, contained in a cylindrical cup of porous queen's ware, and opposed by a circular zink element amalgamated. The connexion was formed by a wire dipping from each zink into a mercury cup excavated in the top of the plumbago cylinders. This battery of six members gave results which were highly satisfactory. In decomposing power, it accomplishes more than 100 pairs of zink and copper of six inches square each. It gave five cubic inches of the mixed gases of water in less than fifty seconds, or one cubic inch in twelve seconds. It also maintained for nearly an hour, at full incandescence, fourteen inches of No. 30 platina wire, coiled into a spiral. In all other modes of exhibition it shows a proportionate power.—B. SILLIMAN, JUN.: *American Journal.*



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# Mechanics' Magazine,

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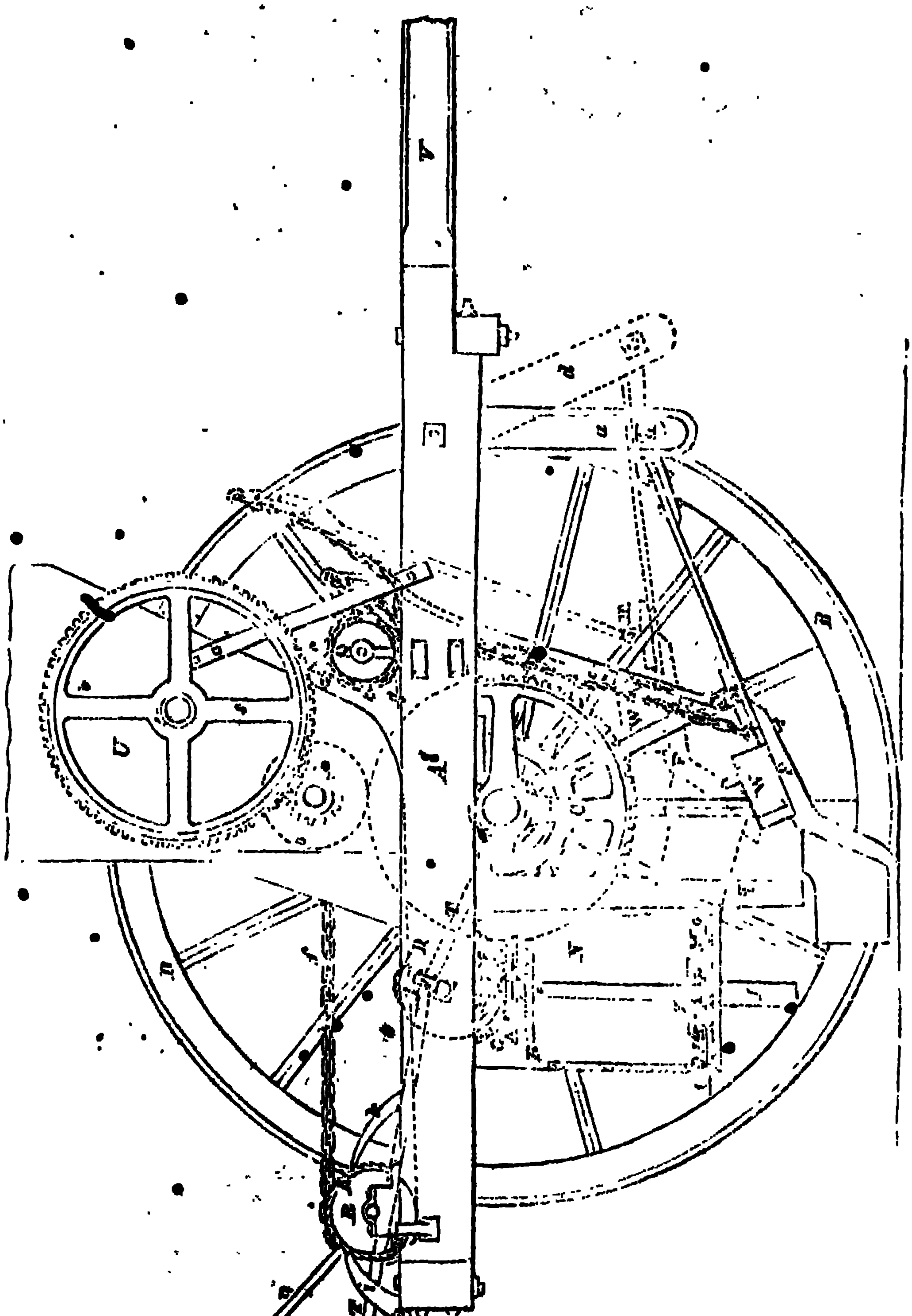


RVING'S PATENT CORN DRILL

Fig. 1.

## DESCRIPTION OF IRVING'S PATENT CORN DRILL, OR MACHINE FOR SOWING ALL KINDS OF CORN OR GRAIN.

[Specification Enrolled, December 7, 1842.]

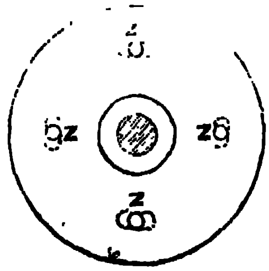
### *Description.*

Fig. 1 of the accompanying engravings is a side elevation of the machine; fig. 2 a plan; and fig. 3 an end elevation.

A A is the frame, to which the various parts of the machine are attached. B is one of the wheels upon which the machine is carried, (the nearest wheel being left out in figure 1 for the sake of clearness.) Upon the axle of the wheels is fixed a toothed wheel C, which takes into, or gears with a smaller toothed wheel, or pinion, D, on the axle of which is fixed another toothed wheel or pinion E. Upon the axle of D there is also fixed two bevelled toothed wheels, F F, which take into, or gear with, two other bevelled toothed wheels, G G, upon each axle of which is also fixed a toothed wheel, or pinion H H, and a circular plate, or disc J J, of metal or other suitable material, called a seed disc. A plan of this seed disc, on an enlarged scale, is given in fig. 3. The toothed wheels, or pinions, H H, take into, or gear with the intermediate toothed wheels, or pinions, K K, which latter take into, or gear with, two other toothed wheels, or pinions, L L, upon each axle of which is fixed another circular plate, or disc, M M, similar to the beforementioned plates or seed discs, which said discs are perforated with holes *z z*, of any required number and size, as shown in fig. 3.

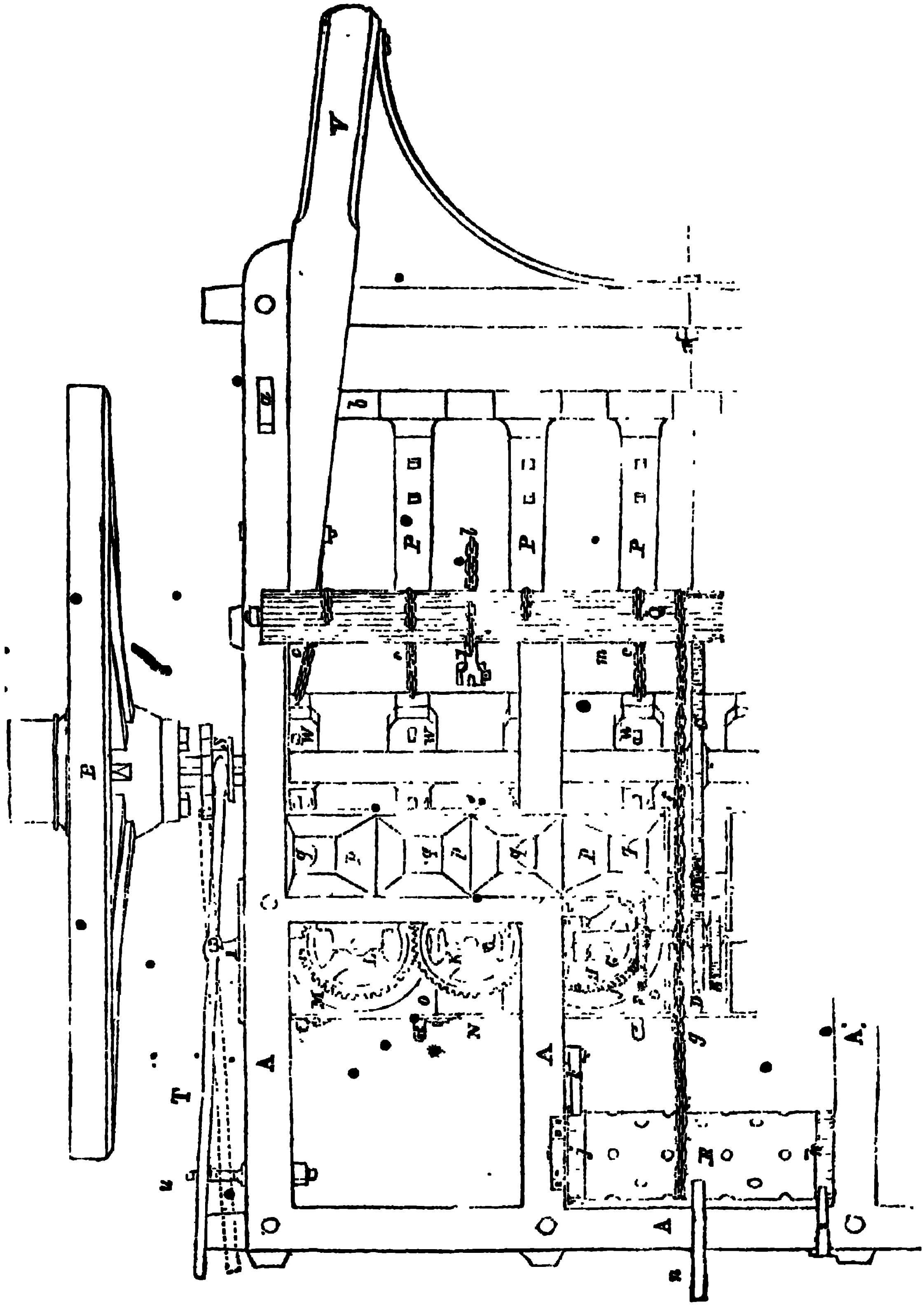
N is a box or trough to contain the seed; the bottom has holes perforated in it, and there are spouts, or tubes I I, (made of leather, tin, or other material,) attached to each hole, the number and width apart being regulated by the number of furrows, and the width between each furrow. O O, are plates of metal or other material fixed upon the interior of the bottom of the seed box. These plates have recesses in them to receive the circular plates, or discs J J and M M, which are accurately fitted to the recesses in the plates O O, allowing the seed discs to turn freely therein; the upper surface of the seed discs and plates are to be flush. Above each of the holes in the seed box, are fixed small stiff brushes X (sufficiently large to cover the holes in the seed discs,) the surfaces of which brushes press close upon the upper surfaces of the seed discs, for the purpose of clearing the holes, and only allowing the requisite quantity of seed to pass through each time. To facilitate the passage, and to ensure the proper quantity of seed, the holes in

Fig. 3.



the seed-discs are made wider on the under surface. P P are the coulters, similar in form and material to those in general use, and arranged to suit any inequality of surface they may have to pass over or act upon. *a a* are two arms of wood, iron, or other material, which are attached to the frame A A, so as to admit of their being moved when required, into the position shown by the dotted lines *d* in fig. 1. Attached to the arms *a a* is a rod or axle *b*, which passes through the eyes or sockets at the ends of the coulter blades, and which eyes or sockets allow the coulters to turn freely upon the axle or rod *b*, so as to act separately or together as required. Q is a roller or drum attached to the frame A A, and moving freely upon its axis. The chains *c c* are attached at one end to this roller or drum, the other ends being attached by a hook to each of the coulters P P. The ends of the chains *e e* are also attached to the roller or drum Q. These chains are further attached to the upper ends of the levers *l l*, the other ends of the levers *l l* being attached by a joint to a board *m*, which, together with the levers *l l* and chains *e e*, are used as a press upon the coulters, as will be more fully explained hereafter. Attached to the roller or drum Q are two other chains, *f g*, (the latter being indicated by a dotted line in fig. 1,) which pass, one over the other, to another roller or drum R, around which they are passed and attached. The roller or drum R moves freely upon its axis, and has at

Fig. 2.



each end a ratchet wheel *h i* fixed upon it, each being provided with a pall *j k* to act in opposite directions to each other. The roller or drum R is perforated with any convenient number of holes to receive a handle or lever *n*, to be used to turn the roller when required. S S are two clutches which slide upon the axle of the wheels B B. T T are the clutch-levers, by which, and the clutches S S, the machine is thrown in or out of gear, as occasion may require. U is a receptacle or box for manure (omitted for clearness' sake in the plan fig. 2), and the apparatus for distributing the same. *o* is a toothed-wheel or pinion (indicated by the dotted line in fig. 1), which takes into or gears with and receives motion from the toothed-wheel C upon the axle of the wheels B B. Upon the axle of the wheel or pinion *o* (which axle is not shown in the drawing) are fixed the spoons for supplying the hoppers or funnels *p p*, and spouts *q q*. Upon the end of the same axle is fixed the toothed-pinion *r*, which takes into and gives motion to the toothed-wheel *s*. On the axle of the latter there are fixed arms or spurs (not shown in the drawing) which revolving through the manure in the box U, keep it agitated, and thereby facilitate the regularity of the supply required for the spoons. V V are parts of the shafts; *t t* are slides which pass between the bottom of the seed-box and the under sides of the seed-discs, having a hole in them to allow the seed to pass through, but when drawn partly out they stop any of the holes that are not required to be used; *u u* are rests for the clutch-levers; *v v* are fulcrum-pins for the clutch-levers; *w w* are weights that are placed upon the coulters to prevent them from rising.

The action of the machine is as follows: by placing the clutch levers in the position indicated by the dotted lines on the plan, fig. 2, the clutches S S are thrown into gear with the wheels B B. Motion being given to these, it is thereby communicated to the toothed wheel C, and by the latter (at the same time) to the toothed wheel or pinion D, the bevelled wheels F F and G G, and the toothed wheels or pinions, H H, K K, and L L, thereby causing the circular plates or discs J J and M M (affixed to the axles of the toothed wheels or pinions H H and L L), to revolve under the seed in the box N N. As these discs J J and M M revolve, the seed falls into the holes in the discs that are exposed to it, in which the seed passes round until it arrives under the brushes X, and over the holes in the bottom of the seed-box. The brushes X clear away the superfluous seed, only allowing the requisite quantity to drop through the holes and spouts I I, into the furrows, singly or severally according to the size of the holes in the seed discs; the distance between the dropping being regulated by the number of holes in the seed discs, and the proportion the several wheels and pinions bear to each other. At the same time that motion is communicated to the toothed wheel C, to the toothed wheel or pinion D, the bevelled wheels, E F, &c. It is communicated by the same means to the toothed wheel or pinion *o*, the spoons and the pinion *r* upon its axle, to the toothed wheel *s*, and the arms or spurs upon the axle of the latter, thereby causing the manure to drop through the hoppers or funnels *p p*, and the spouts *q q*, into the furrows or drills, a little in advance of, and simultaneous with, the seed or grain from the spouts I I. A certain supply of a given quantity of manure is thus insured to every portion of grain or seed as it is sown, and as both are discharged so near the ground, they are affected but little (if at all) by the wind, before they are deposited in the ground.

The coulters may be of any approved form, and are so arranged in this machine as to be capable of making the furrows of any depth the soil will admit, or the seed may require. These arrangements are such, also, as to allow them to act separately or together, as circumstances, or the inequality of the surface may render necessary. When the furrows or drills are required to be deeper than the coulters and weights, in their ordinary position, will make them, the pall *k* is released from the ratchet wheel, and thrown back, the handle *n* is inserted in one of the holes in the roller or drum R, nearest the back frame A of the machine, and the roller or drum R is turned round towards the front of the machine, and the chain *g* (indicated by the dotted line in fig. 1.) is wound upon the roller or drum R, thereby causing the roller or drum Q to revolve, and take up the chains *e e*, attached to the upper ends of

the levers $l\ l$, which being thus drawn down, makes the lower end of the same press down the board $m$ (to which they are attached) upon the coulters, forcing them into the ground to any depth that may be found expedient. When they require to be raised, the pall $j$ is released, the roller or drum R is turned back, taking up the chain $f\ f$, and causing the roller or drum Q to revolve and take up the chains $c\ c$, thereby raising the coulters to their original position, or to the position indicated by the dotted lines in fig. 1, so as to be entirely out of the way of any obstruction that may offer itself upon the ground.

When the seed is required to be dropped nearer together than the machine in its present arrangement is capable of effecting, all that is required to be done is, to loosen the screws by which the plummer blocks, that carry the axles of the wheels B B, are fixed to the frame A A, and move them (the plummer blocks) back, or move the frame forward, (slots being provided in the plummer blocks, through which the above screws pass). The toothed wheels or pinions, D and E, having been moved along their axle, until the pinion E takes into or gears with the toothed wheel C, they are then fixed upon their axle by their keys or cotters; the plummer blocks are screwed firmly to the frame A A, and the machine is again ready for use.

The principle of this machine admits of many other modifications, by which it may be made applicable to the sowing of all kinds of seed or grain, and under every variety of circumstance. It may, for example, be constructed of a greater or less width, so as to drill and sow a greater or less number of furrows than the machine shown in the engravings; or it may be adapted to one or more horses, so that the horse or horses may walk upon the lands immediately in front of the machine, or in the trenches on each or either side. A hand-machine on the same principle might also be readily constructed.

*Claim.*—"I wish it to be undertood, that, in the machine herein described and shown, I do not claim the manure apparatus shown and described, nor do I claim the form of the coulters, but I claim those peculiar arrangements as herein described, and as shown in the accompanying drawings; I also claim the application and use of perforated plates or discs for dropping or sowing all kinds of seed or grain, and their combination with wheels and pinions or other mechanical contrivances, for the purpose of carrying out the principle and its application as herein described, and as shown in the accompanying drawing."

*Remarks.*

The machine, as shown in the accompanying engravings and before described, is arranged for drilling and sowing eight furrows at once; but, as stated in the description, it is not confined to that number, but may be made to drill and sow any number of furrows, within reasonable limits. The principal advantage which the machine offers is, the saving of seed or grain; it being intended, and so constructed, as to sow or deposit the seed in one, two, or three grains at a time, instead of the trail, or continuous discharge of the drills generally in use at the present day. It is found by experience that sowing two or three grains in one spot, with a clear space of four, five, six, or even nine inches, between them and the next adjoining cluster of seed, allows more room and nourishment to each root, and a freer circulation of air, and produces a fuller and stronger crop, than when the seed is sown in a continuous trail in which case the roots are crowded and impoverished, so that only a part comes to perfection. It is calculated that the quantity of seed saved by this machine will not be less than two-thirds, if not three-fourths, of that ordinarily required.

PROGRESS OF FOREIGN SCIENCE.

## *Dr. Moser's Discoveries.*

Professor Möser, of Königsberg, has, within the last few months, published in Poggendorf's Annalen, and elsewhere, a great number of observations and experimental results connected with photography, which are not only most remarkable from their singularity and novelty, but of the highest importance, as for the first time laying open the action of minute and hidden forces in nature, operating in a way never before so much as suspected. Some slight notice of these researches was given by Professor Bessel, the astronomer, to the British Association at Manchester; but as no complete account of them has yet appeared in English, it seems desirable

here briefly to trace their progress to the present date.

It has for some time been known that when an ordinary silver plate (prepared for Daguerreotype purposes) is exposed for a certain time to light reflected from objects in the camera obscura, after having received the coating of iodine vapour, an image is produced of the objects on the plate, without the use of mercurial vapour. But the image is a *negative* one; that is to say, the lights and shadows are reversed. On the Continent, such an image is called negative, while an image in which the lights are light, and the shadows dark, is said to be *positive*. In Daguerre's process, nothing appears upon the iodated plate until after it has received the mercurial vapour. Nevertheless, the experiments of Edmund Becquerel show that an extremely short time is sufficient to affect the iodated surface in such a way that if the plate be placed in the sunshine, under a red glass, the latent image becomes gradually more and more visible or distinct, on applying the mercurial vapour afterwards, although (it will be observed) the objects which originally, as it were, impressed the image are no longer in presence. Hence he has distinguished the acting rays into "exciting rays" and "continuing rays."

Möser has found that in the preceding case, if the action of the red glass be continued long enough, the image (a negative one) appears without the use of mercury at all.

Gaudin had previously found that yellow glass acted as efficaciously, or more so, than red in these conditions.

Möser has observed the following singular fact. A plate iodated, which had been exposed in the camera for the usual time to give a positive image with mercury, was taken out, and placed in the sun under yellow glass, no image being as yet visible. Presently, a negative image appeared, which disappeared again in a few seconds: and in about ten or fifteen minutes there appeared in its place a positive image.

Here we may remark, that the rays passing through the yellow glass played the same part that the vapour of mercury does. The positive image will not appear, using red glass, however long the exposure; but it succeeds well with green glass.

On the as yet untouched iodated plate, the violet and blue rays are those alone of the spectrum which are active. They produce that invisible change of molecular arrangement which is made visible to the eye by the mercurial vapour; but there are two periods distinguishable in this action. At the end of the first, the red and orange rays act upon the plate as well as the blue or violet, and the yellow are inactive; at the end of the second period, the yellow and green rays act in their turn. The plate is then just at the point when the mercurial vapours act upon it in rendering the image visible.

When an iodated plate was exposed in the camera, until a very distinct negative image was produced of objects illuminated by sunshine, and the plate then taken out and exposed to direct sunlight, the former image soon disappeared, and a positive image appeared in its place, in which the lights had a green tint, and the shadows a dark red brown. The latter effect Möser attributes to the yellow and green rays. When a plate coated with chloride of iodine was exposed in the camera, in winter, for thirteen days, a positive image of great beauty was produced; the lights had a sky blue colour, and the shadows a fiery red. The plate being then immersed in a solution of hyposulphite soda, the positive image disappeared, and in its place came forth a negative one.

Polarized and unpolarized light produce precisely similar effects in these conditions.

Placing a prism of carbonate of lime, achromatized, for one of the images before the lens of the camera, and adjusting for a statue as an object, two images were obtained upon the plate, of which one was achromatic to the eye. Images of coloured rings, figures given by polarized light seen through crystalline plates, &c., when received on the photographic plate, were identical with those seen directly by the eye.

It has been long known that when a plate of polished glass is written upon with certain substances, the writing effaced, and the surfaces cleaned, yet on breathing upon the glass the characters reappear, by means of the different arrangement of the particles of moisture condensed from the breath.

Möser has extended this phenomenon

to all polished bodies, and to all substances whatever used for writing on them; these being such, of course, as produce no visible change on the surface. It is even true of an undisturbed surface of quicksilver after many days, if not disturbed. If a perforated screen be placed against a plate of glass, and the latter breathed upon, and the screen be now removed, and the glass again breathed upon, after the moisture from the first has evaporated, the form of the perforations will be rendered visible.

Regnault thinks fatty matter deposited from the breath may have something to do with this.

Möser has found that when solid objects, such as medals, intaglios, &c., are placed in contact with a silver iodated plate, after a shorter or longer time an image of every part of the surface in contact is traceable upon the place. This takes place with equal rapidity, certainty, and minute accuracy in *total darkness* as in daylight. An image of an object which has been in contact with a polished silver plate may also be obtained by merely exposing it to the vapour of mercury afterwards, without any previous application of iodine.

From these facts he concludes that the parts of a surface touched by another body, affect variable affinities for the vapour of substances to which it may be exposed; so that contact here produces an effect analogous to light. Thus when medals, rings, &c., were laid upon an iodated place in total darkness for a night, an accurate image of every line of the contact surface was formed when the plate was exposed to vapour of mercury. Plates treated in the same way, but exposed to diffuse solar light, in place of the mercurial vapour, also showed the images as before. The same plates, exposed to coloured rays, gave slight traces only under red glass or yellow, but well defined images under violet.

When a polished plate of silver, which had never been before used, was exposed to sunlight for some days, under a black perforated screen, placed very close, but *not* in contact with it, on exposure of the plate to the vapour of mercury, the image of the perforations became distinctly visible. The same experiment succeeds with a plate of copper, when exposed to vapour of iodine. The same also with a plate of glass, when breathed upon, or exposed to vapour of water.

These experiments show that contact of bodies produces certain effects analogous to those of light; but a much more remarkable result of Möser's is, *that any two bodies, when sufficiently near, impress their image one on the other, although both be in absolute darkness.*

Thus an agate or an intaglio, placed opposite to a polished silver plate, at a small distance, in total darkness, after a longer or shorter time, occasionally in ten minutes, has impressed its image on the plate, visibly to the eye, without any previous exposure to vapour.

Phosphorescence has nothing to do with the phenomena; and if they arise from radiation, it must be concluded that the effect of the radiant matter diminishes very rapidly with the amount of obliquity produced by the distance of the object.

An engraving, placed for about twenty minutes upon a plate of polished silver, leaves its image, rendered quite visible by vapour of iodine and mercury afterwards.

These remarkable results of Möser's have been verified at Berlin by Aschersohn, and in presence of Encke.

From these researches, of which the foregoing is an imperfect outline, Möser deduces the following general propositions:

1. Light acts on all bodies, and on all in the same way. Actions heretofore known are particular cases of this general proposition.

2. The action of light so modifies the surfaces of bodies, that they condense vapours differently after exposure thereto, from what they do before. Daguerre's discovery is a particular case of this proposition.

3. Vapours are condensed more or less forcibly by bodies after being exposed to light, in proportion to their own tension, and to the intensity of the light.

4. Ioduret of silver, as is known, is at first blackened by light.

5. But if the action be continued, it becomes coloured.

6. The different refrangible rays all act alike, but require different times to produce like effects.

7. The violet and blue rays, and the

invisible rays of "Ritter," rapidly originate the blackening of iodurate of silver. The other rays, to produce equal effects, require times inversely as their refrangibilities.

8. The colouration of 5 is produced most rapidly by the red and yellow rays; the other rays require, to produce equal effects, greater time, as their refrangibilities are greater.

9. All bodies radiate light, even in total darkness.

10. A property which does not seem to be of the nature of phosphorescence; for no difference of effect is perceivable between the same body, after exposure to sunshine, and after being long in darkness.

11. These rays act on all substances, like the direct rays of light.

12. These rays, insensible to the retina, have a refrangibility greater than those of direct or diffuse solar light.

13. Two bodies in total darkness always mutually impress their images.

14. But, in consequence of the divergence of the rays, the bodies must be very close (though not in contact), that the image may be visible.

15. Any vapour may be used to render such images visible.

16. As these rays are more refrangible than any hitherto known, they are those which ordinarily commence action (as in 7) on other bodies.

17. There exists a *latent light*, as there is known to exist a latent heat.

18. When a liquid is evaporated, the light which corresponds to a certain period of time, becomes latent, and is again liberated when the vapour is condensed.

19. Hence it is, that light and vapours produce in some respects the same effects.

20. The condensation of vapours on plates acts like light; so that vapour in excess simply adheres—as the vapour of water to most substances—or acts permanently in adhering, as vapour of mercury; or, finally, acts chemically, as vapour of iodine.

21. The latent light of the vapour of mercury is yellow; all the actions which the yellow ray produces can also be produced by the vapour of mercury.

22. The latent light of vapour of iodine is blue or violet, and the actions of these rays can be produced by its vapour.

23. The latent light of chlorine, bromine, chloride and bromide of iodine, seem to be the same as of iodine simply.

24. As to the latent light of vapour of water, Möser can only say, that it is not red nor yellow, nor orange nor green.

25. Ioduret of silver owes its sensibility to light to the latent light of the vapour of iodine.

26. Ioduret of silver is not more sensible to invisible rays than silver itself.

Some of these propositions admit of much doubt at present. Those, however, which merely enumerate facts in this general form are worthy of every attention.

Since attention has been drawn to this class of phenomena, other facts have been recorded, long since observed by other persons, but of a strictly analogous and most interesting sort. Thus Breguet, the celebrated chronometer maker, has stated, in a letter to Arago, that he has constantly observed the name of his firm, which is engraved on the brass cap covering the works of their watches, impressed, in an inverted image, on the polished interior of the watch case of gold or silver; the engraving having been, of course, when the watch was shut up, for a longer or shorter time, in close propinquity, but not in contact with, the interior of the case, and in total darkness.

Further, M. Rauch, the sculptor, has observed a complete image formed on the surface of a plate of glass, which had covered an engraving, of the subject of the print, although the glass did not touch it; and, it seems, this fact is familiar to engravers.

Möser has found that these images of prints on glass may be produced in a very short time. The image appears brighter or lighter coloured than the rest of the glass, and is easily rubbed off.

An engraving takes nine days to produce such an image, at a distance of from $\frac{2}{10}$ to $\frac{3}{10}$ of a line of the glass.

He has produced similar images on surfaces of copper, brass, zink, and gold, in five days. Möser proposes to repeat his experiments *in vacuo*, and is at present eagerly occupied with them.

Amongst other Continental discoveries relating to photography, is that of M. Lechi, of a mode of colouring Daguerreo-

types, after they have been formed by the usual process. The general outline of the process, of which no details have yet been published, consists in covering each portion of the plate with a coat of transparent colour, of the required local tint, in water-colours, and washing off the excess of non-adherent colour almost instantly in warm water; enough adheres —it appears, in fact, to sink into the plate—to give all the effect, it is said, of a very finely finished, but peculiar looking water-colour drawing.

The applications to forgery, it may be added, which Möser's discovery will soon afford, will, before very long, render new and difficult means requisite to prevent it in the preparation of bank notes, bills, &c.

R. M.

### CLEANSING OF WATER PIPES.

Sir,—Some remarks have recently been made in your Magazine on the accumulation of dirt in the mains of the water companies, and the great difficulty of cleansing them, which, it is supposed, can only be done by "taking them up," and this is rightly judged to be too expensive a remedy to be even "hoped for."

I think a very small share of common sense, rightly applied, will enable every impartial reader to perceive that this would not only be an expensive, but really a needless remedy.

Either the objectionable deposits in the water pipes are capable of being acted upon and removed by the water, or they are not. If they are capable of being carried off by the current, it is only necessary to get that useful functionary "the turncock" to open a plug or two on the lower levels of the district, to get rid of the offending matters at once. But, if there be any deposits that are of such a ponderable character as *not* to be moved by the rush of water towards these large orifices on a low level, we may depend upon it, they will never annoy us by ascending through the instrumentality of a more moderate stream into our elevated cisterns.

The remedy referred to above, is the one that is almost daily employed in various parts of the metropolis, and is so efficient for the purpose, that there is really no necessity for taking up, either the pipes, or any more of your space with the matter.

I remain, Sir, yours respectfully,

WM. BADDELEY.

29, Alfred-street, Islington.
November 19, 1842.

### CANAL NAVIGATION.

Sir,—Having recently visited a neighbourhood where a canal, depending upon casual supplies, is often, if not always so low towards the end of summer as to allow of no more than half cargoes being brought up, and that, often, at the expense of six or eight horses to drag the barges by sheer force over the bottom, it was suggested to me by a gentleman, that rollers might be advantageously applied, and upon consideration, I beg to submit, through the medium of your valuable Magazine, the following plans for the comments of those practically acquainted with the subject of canal navigation, of which I freely confess my own ignorance. My object would not be materially to increase the cargo at such times, but merely to render a much smaller amount of power necessary to drag the barges over the flats. I propose to furnish each flat-bottomed barge with three or four, or any other number of cast-iron rollers, say, 6 or 12 inches diameter, running on pivots, 6 or 12 inches long, at certain distances along her bottom, on each side about half way between the keelson and the extremity of her bottom, such rollers to project only such a distance as may be deemed or found most advantageous, and to run in recesses constructed in the bottom for the purpose, which could be easily contrived.

It may be objected, that the rollers would be useless in muddy bottoms, but I would submit, that as mud accumulates generally in the holes, or deeper parts of water, leaving the shallower parts free from it, the objection, taken generally, does not militate against my plan. It is not improbable that some such may already be in existence, of which myself and neighbours would feel obliged for an account.

I remain, Sir, yours, respectfully,

J. B. S. C.

Oakham, November 19, 1842.

## FOUR-WHEEL LOCOMOTIVE ENGINES, AND THE EFFECT OF INSIDE AND OUTSIDE BEARINGS.

Sir,—Being constant readers of your Magazine, the letter of your correspondent, signed "A Practical Engineer," in your October Number, page 341, in respect to the jumping of four-wheeled locomotive engines, did not escape us; and we have been considering whether, after all the proofs which have been afforded of the superiority of four-wheeled engines (provided, always, that they have inside framings), it was worth our while to take the trouble of replying to a person who fights behind a mask, and attacks opposing opinions under an anonymous signature. Our inclination was to let such a person sleep quietly in the obscurity he had chosen, as an object unworthy our notice. But in your November Part, in which you have spontaneously inserted our circular, and a sketch of our four-wheeled engines, you prefix some remarks of your own, in which you refer to the communication of the "Practical Engineer," as coming from a "gentleman of as high authority in railway matters" as ourselves. We, therefore, now call upon that gentleman to come forth and state his name, that the public, as well as ourselves, may judge of his "authority" in such matters; and that we may have the opportunity not only of meeting the statements he has ventured to put forth, but to enter the lists with him, in the open face of day, upon the whole question—for which we are fully prepared. The public will then be able to judge for itself. We cannot think this gentleman will decline our challenge, and shrink from avowing himself; or that you will refuse the insertion in your Magazine of a discussion which you have assisted in provoking by your own remarks. At the same time we reserve to ourselves the right to decline entering into the controversy, if your correspondent should perchance prove to be a person of whose authority in such grave and important matters we have no opinion; and we shall not hesitate publicly to give that as our reason in such a possible case.

We take leave to advert here briefly to your article in the October Number, headed "Progress of Foreign Science," subject of the Versailles railway nt, of the 8th of May last, in which you gave a garbled* extract of M. Seguier's opinion, delivered to the Royal Academy of France. We can only quote your own words, as applied by you to the second communication on that article, if M. Seguier has been rightly reported, and say, "It affords an admirable specimen of the talent in which Frenchmen are so peculiarly happy, of slurring over a difficulty, and raising a fog about a subject, which, while they do not understand, they will not admit their ignorance of." We fear many of our *soidisant* "practical engineers" are in the same predicament as the Frenchmen.

Trusting to your candour for the insertion of this letter, we are, Sir,

Your obedient servants,

BURY, CURTIS, & KENNEDY.

Clarence Foundry, Liverpool,
December 8, 1842

P.S. We enclose a lithographed sketch of the effects of inside and outside framing, with the broken axle, which illustrates what you are pleased to call "the singularly ill contrived and inconclusive experiment on the London and Birmingham Railway," and which we think will convey some instruction of an useful and interesting nature to your readers.

[We give on the opposite page the engravings referred to by Messrs. Bury, Curtis, and Kennedy, and subjoin their explanation of the figures.]

*The effect of inside and outside bearings practically explained.*

Figs. 1 and 2. Locomotive engine with inside framing.

Figs. 3 and 4. Locomotive engine with outside framing.

Figs. 1 and 3. Show the position of the wheels with the axle broken.

Figs. 2 and 4. Show the position of the wheels in both engines when running on the railway.

*Explanation of Figs.* 1 *and* 2.—In this engine the bearings are inside the wheels, and the weight of the engine and boiler is carried at A A. The tendency of the axle, therefore, is to bend downwards in the centre, whilst the pressure of the flange against the rails in

* How "garbled?" Imperfect it may possibly be; but garbling implies intentional misrepresentation, and every thing of the sort we most distinctly disclaim.—ED. M. M.

going round curves, has a contrary tendency. Thus one strain counteracts the effect of the other, and if the axle breaks, the wheels can spread out no farther

Fig. 1.

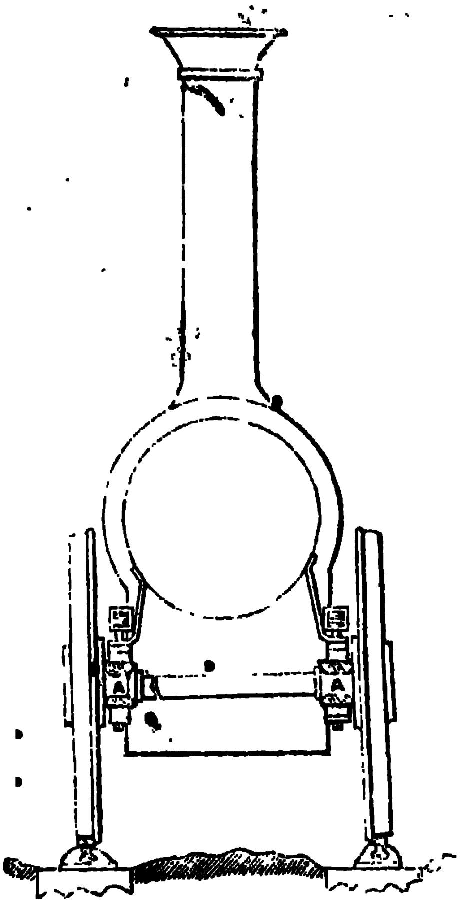



Fig. 3.

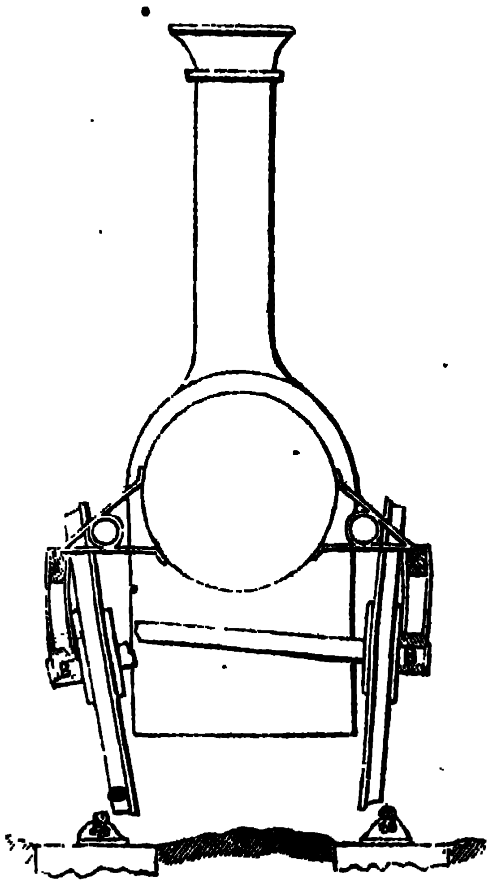


Fig. 2.

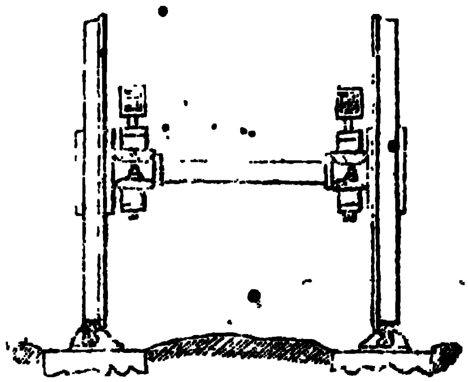
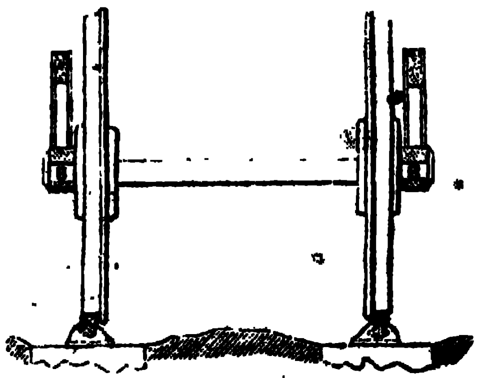



Fig. 4.



below than the amount of allowance for play between the flange of the wheel and the rail. The wheels, therefore, being confined between the rails by the flange

pressing against the inside of the rails, may proceed with safety to the next station.*

*Explanation of Figs.* 3 *and* 4.—The gravity or insistent weight of this engine with outside frame is carried at B B, outside the wheels. The gravity of the engine and boiler in this case tends to bend the axle upwards in the middle, and the pressure of the flange of the wheels against the rails in going round curves, acts in the same direction, and in addition to it. This continued bending of the axle destroys the fibre of the iron, and ultimately it breaks; and when it is broken, the tendency of the axle upwards, as before shown, forces the wheels between the rails, there being no flange outside the wheels to prevent it, as is shown in fig. 3.

EXPERIMENTS ON THE EXPLOSIVE EFFECTS OF CERTAIN MIXTURES OF GUNPOWDER AND AIR. BY CHAS. THORNTON COATHUPE, ESQ.

Sir,—The following experiments illustrating certain effects produced by the explosion of gunpowder, may be interesting to some of your readers. Being exceedingly fond of rifle-shooting, it so happened during a morning's practice, that the ball became so fixed in the barrel at a short distance above the charge of powder, that I could not, with the implements then present, force it "home." I had often heard of guns bursting from similar incidents, but having duly surveyed the substance of the metal around the bore of the barrel, I thought—*well, this cannot burst.*

The rifle was very small, having two grooves in the barrel, and carrying a ball weighing the $\frac{1}{48}$th of a lb. avoirdupois. The charge of powder was 20 grs. of the best quality ("extra canister"); the target was a wrought-iron plate $\frac{1}{4}$ inch thick; the distance was 100 yards, and the usual effect upon the target was the slightest possible indentation of the surface upon which the ball impinged, (the ball being smashed to atoms).

On this occasion, however, the ball all but perforated the entire substance of the plate. The indentation was deep and conical, bursting open the opposite surface of the plate.

It immediately occurred to me that this unexpected result might be turned to advantage, by making barrels so strong that, instead of the thus increased force of an ordinary charge of powder being spent in bursting the tube in which it might happen to be exploded, it might be expended in propelling its ball. I therefore had a small cannon manufactured of twisted wrought-iron, and bored from the solid mass, leaving the substance of iron around the bore so thick that it could not be injured by any method of exploding gunpowder within it. Its bore was 11 inches long, and its calibre suited a ball weighing $\frac{1}{23}$rd of a lb. avoirdupois. It was charged with 56 grs. of Curtis and Harvey's "canister powder," and it was fired at a target composed of 8 planks of half-inch elm board, under the following circumstances, each experiment being repeated three times. The distance was 10 yards.

| | Ball through | and into |
|---|---|---|
| 1st average, powder and ball alone | 5 planks | 6th |
| 2nd do. with air equal half bulk of the powder | 5 do. | 6th |
| 3rd do. with air equal a whole bulk of the powder | 6 do. and | 7th |
| 4th do. with air equal one and a half bulk of the powder, | 5 do. | |
| 5th do. with air equal 2 bulks of powder | 5 do. (barely). | |

It may be asked how I ascertained that the bulks of air included above the powder were precisely such as I have reported them to have been?

In the first place, I prepared some cylinders of cartridge paper which exactly fitted the bore of the cannon, and having ascertained the requisite length of one of these cylinders to contain just 56 grs. weight of powder, I divided each cylinder as it revolved in a lathe upon a wooden mandril into lengths proportioned to the volumes of air they were intended to contain. Over one extremity of each cylinder thus cut and regulated, I pasted a slip of very thin muslin. In loading, the powder was inserted through a brass tube, the gun being held perpendicularly. The paper cylinder was then slid down upon the powder with the closed end

* For some remarks on this point, see page 572 of our present Number.—ED. M. M.

downwards. Above the paper cylinder a piece of mill-board, cut with a gun-punch of the precise diameter of the bore, was inserted, and above this the ball was placed, and retained in its situation by means of a circular piece of thick card. Previous to each discharge, the gun-carriage was fixed firmly to the ground by an iron rod, that any errors from the recoil of the gun might be obviated.

Although these experiments are of too rough a nature to give the exact effect of each discharge, they still afford an ample illustration of the limits within which air can be advantageously combined with gunpowder for practical purposes. It appears that about equal bulks of air and of powder produce the best results; and this relative proportion of air seems to increase the explosive force of gunpowder by about the one-fifth of that which would have been obtained had the air been altogether excluded. Hence 20 per cent. of gunpowder may be saved, the effects remaining constant; or the usual charges of powder being retained, their effects may be increased nearly in the ratio mentioned above. This principle may be economically adopted either for propelling balls or for blasting rocks.

Yours very faithfully,

CHAS. THORNTON COATHUPE.

Wraxall, near Bristol, December 8, 1842.

P.S. I have other experiments connected with this subject in contemplation, the results of which you shall have in due time, if they should appear worthy to be recorded.

C. T. C.

[We need hardly say that we shall be very happy to receive an account of the further experiments mentioned by Mr. Coathupe.—ED. M. M.]

## THE WATER QUESTION—FILTRATION v. MONOPOLY.

Sir,—I promised some time ago to reply to the "last words" of my veteran opponent Mr. Baddeley, but being suddenly summoned to France, I found no opportunity of doing so, and now, on reviewing the former correspondence, I find that nearly every point of importance has been conceded, and that nothing remains for me to do but merely to acknowledge that the frequent cleansing of cisterns is doubtless a very good thing, though the discovery may not be quite so profound as to entitle the discoverer to claim the laurels of a Newton or an Arkwright; but be that as it may, even such as it is, *it is no discovery of Mr. Baddeley's*, as evidence is already before Parliament of a similar recommendation having been given by the West Middlesex Water Company, as a *ruse* to induce its customers to lay the blame of the dirt and filth they find in their water on their maid servants instead of on the "monopolists."

If your readers or Mr. Baddeley's partizans require proof of this, they may turn to the "Report of the Select Committee of the House of Lords appointed to Enquire into the Supply of Water to the Metropolis," and they will find in the evidence of Mr. W. Clapp, surgeon and vestryman of Marylebone, the following answer:

"The West Middlesex Company have attached a notice to their receipts, stating that if persons who use their water will *keep their cisterns clean*, they will find a very great improvement. Now I am perfectly willing to acknowledge that the water is much clearer to the eye than it used to be; there are not so many visible insects, not so many shrimps swimming about it, nor so much mud mixed up with it, but the water is equally impure."

So much for the *originality* of Mr. Baddeley's improvement, about which he chuckles with so much complacency, and to which he attributes such magical influence in causing a ten times greater number of cisterns to be cleansed now than was formerly the case, a circumstance (*if true*) which proves the great influence of the *Mechanics' Magazine* rather more than the science or skill of its particular correspondent. Mr. Baddeley must put the laurels he has been displaying somewhat too ostentatiously into his pocket, the West Middlesex Company having a prior right to them.

But now comes another champion of the monopolists, with the initials S. R. B., a great epithet-monger, or, as Mrs. Malaprop would call him, "a nice deranger of epitaphs," and he, forsooth, must hurl his ponderous wit against all who will rather prefer not to drink water charged with the filth of a hundred thousand temples of Cloacina, besides divers masses of decomposed vegetable and animal matter, if they could get it in a purer state.

Alas for the champions of the monopolists! One and all discover the cloven foot almost immediately on their entering the lists. This worthy gentleman, who really thinks, after all, that water may perhaps

be quite as good, or possibly all the better for the beautiful virtues with which it is blended from the aforesaid temples and other sources—(tastes *will* differ, you know, Mr. Editor),—this very gentleman tells us in one page that he has been drinking the New River water for forty years, and "is perfectly sound under the treatment;" and in the next confesses that all the water he drinks "*unboiled*" is taken from *wells*, leaving it to be inferred that the soundness of his constitution arises from drinking all other water after it is purified by fire. A very nice admission from a champion of the monopolists.

The following paragraph is really exquisite in its way. I am sure your readers will not grudge to read over again so much fine writing, especially as it is incumbered with such a small tax upon their brains:

"Now, thank goodness, Mr. Editor, I am still cockney enough to bless the name of Sir Hugh Middleton, and to think him one of the greatest benefactors of the human race, in a joint stock company way, that has ever appeared. But since it is plain that we are not much longer to be suffered to use the undisintegrated water of the silver Thames and the chalk-fed Lea, prepared in Nature's most perfect laboratory, I thank my stars that, by the blessing of Providence, guiding the hand and wit of man as its instrument, there are ample supplies of pump-water in all parts of London, (inaccessible to the approach of filterers,) from which I myself, and my neighbours too, (judging by the number of pitchers that are seen carrying about just before the hour of dinner,) are supplied with all the unboiled water which we drink."

Is not this logic delightful—almost as extraordinary as Mr. Baddeley's important discovery of cleansing cisterns? To begin with praising Sir Hugh Middleton for the New River water, and to end with declaring that "all the unboiled water" the worthy gentleman and his neighbours drink is taken by pitchers from *wells*, and not one drop "unboiled" from the aforesaid Sir Hugh Middleton's New River Company.

This gentleman is however wise in his generation; he only recommends *others* to drink the unfiltered water of the various companies; he does not drink it unboiled *himself*. To others he thinks it really may be all the better for having lime in it, nay, considered almost perfect from the admixture of gas manufactories, dead leaves, and rotten bunchases, and quite superlative, no doubt, if well amalgamated with the contents of a hundred common sewers—only he would not drink it himself!

These things, however, are all matters of taste. A great authority, almost equal to "the nursery maid," who taught the erudite gentleman "philosophy and fudge," y'cleped, I believe, Joseph Miller, records an instance of a brewing of ale into which a black man fell, was drowned, and was boiled, making the "barley bree" all the richer in the estimation of the customers for having so much precious material in addition to the malt and hops. So indeed, if it be as this gentleman says, beneficial to drink "lime" in water, in order to furnish the proper *pabulum* for our bones, so it may be equally beneficial to take over again in the unfiltered water of the metropolitan monopolists' decomposed matters with which our stomachs have been previously acquainted.

But a truce to such nonsense and such perversity of taste. Those slight skirmishes in favour of dirty and unhealthy water, or rather of the avarice that prevents such water being cleansed and purified, can last but for a short period. I observe by the *London Gazette* and the *Times*, that Mr. Stuckey's plan of filtration is coming before Parliament, and Parliament is the proper arena in which the battle can be fought. God defend the right!

I have the honour to be, Sir,

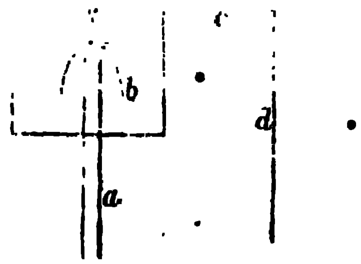
Your obedient servant, B.

## IMPROVED VENTILATION OF MINES.

(*From the Mining Journal.*)

Sir,—In the *Mechanics' Magazine*, of the 1st October, is described the principle of "certain improvements in the construction and application of rotary engines," for which I have taken out letters patent; to one branch of those improvements, may I beg to call the attention of those interested in mining affairs, through the medium of your valuable Journal—viz., to an improved ventilation of mines. I have recently had constructed and applied in a colliery, belonging to Earl Fitzwilliam, a ventilator, on the principle described in the above journal. It is a wheel, four feet in diameter, six inches deep, and having ten vanes or arms, with the outer extremity at an angle of forty-five degrees with the plane of motion; upon the periphery of the wheel are a number of small buckets to receive the jet of water, which is the power employed to give motion to it. The wheel is fixed in the circular opening of a vertical wooden frame, placed near the bottom of the air-shaft; the stream of water, which moves the wheel, falls down the shaft, from a cistern fixed in the side, twenty-six yards from the bottom. The cistern will contain fifty-four gallons, and,

at present, the supply fills it in four minutes twenty seconds, so that the available power to turn the wheel is the weight and momentum of about twelve and a half gallons of water per minute, with a head of seventy-eight feet. The water from the cistern is conveyed to the wheel through a lead pipe, one and a half inches in diameter, and issues thereon through a conical jet, three-eighths of an inch in diameter, which is rather too large for the supply of water at present falling into the cistern. So long as water remains in the cistern, the issuing jet is sufficient to turn the ventilator 136 revolutions per minute, which is reduced to 116 per minute when partially working upon air. In order to provide for a larger supply of water falling upon the wheel (as it is thought, after so long a dry time, that the present supply is nearly a *minimum*), the discharge pipe *a*, through the bottom of the cistern, reaches nearly to the top, and a moveable cap *b*, fits over it, which is balanced on a lever *c*, and can be regulated to any height by a wire *d*, extending to the bottom of the shaft; it, therefore, acts as a syphon, and gives the stream an intermitting character, more or less frequent, at pleasure, as, when the water in the cistern is below the bottom of the cap, the air getting underneath, stops any further outlet until the cistern is again filled, when it reissues with full force, as before.




With regard to the quantity of air which passes through the ventilator, according to the principle described in the *Mechanics' Magazine*, and which, I have every reason to believe is perfectly correct—a cylinder of air, having a base of four feet diameter, and height the circumference of the wheel (4 x 3·14), will pass through at every revolution. This cylinder is equal to 157·8 cubic feet, so that, with a stream constantly issuing from a three-eighth jet, with a head of seventy-eight feet, upwards of 21,000 cubic feet of air would be withdrawn from the mine every minute; or, in this case, with the present supply of water, upwards of 18,000 cubic feet; or (to state the case differently), in the first instance, the air passes through the ventilator at the rate of 28½ feet, and in the last of 24½ feet per second. That the air passes through in lines perpendicular to the base, and at uniform velocity at any point of the wheel, is clearly shown, when holding a piece of lighted tarred rope within the influence of the wheel, by the appearance of the smoke and flame; or, if the rope be allowed to touch the wheel, by the direction of the sparks, which are thrown off with great velocity, in lines perpendicular to the wheel, for a considerable distance.

The advantages of this method of ventilating over the "furnace plan" (especially, as in this instance, where the power costs nothing), will be at once obvious to all acquainted with mining affairs, for, when once set in motion, its action may be said to be perpetual, and will need no further attention than occasionally a little oil to the axle. It removes all danger to which a furnace is liable from contact with the carburetted hydrogen; and, what is of more importance, as being, perhaps, the greatest source of accidents, it removes the danger arising from the carelessness or neglect of those appointed to attend the furnaces, and its cheapness and simplicity can scarcely be excelled.

BEN. BIRAM.

Wentworth, Nov. 24.

*To the Editor of the "Mining Journal."*

Sir,—After writing the above letter, I forwarded it to Milton, for Earl Fitzwilliam's perusal, who has kindly returned it to me, with the accompanying testimonial. By inserting them in your valuable Journal, you will confer a great obligation on,

Sir, your very obedient servant,

BEN. BIRAM.

Wentworth, Dec. 1.

*To the Editor of the "Mining Journal."*

Sir,—Before I left Wentworth the apparatus described in Mr. Biram's letter had been fixed, and having myself seen it in operation, I can bear witness to its efficiency. Of its superiority to a furnace, there cannot be the slightest doubt.

I am, Sir,

Your very faithful servant,

FITZWILLIAM.

Milton, Nov. 29.

## PARKER'S FOUNTAIN LAMP IMPROVED.

Sir,—In No. 939, August 7, 1841, of your Magazine, you gave insertion to two designs of a pneumatic lamp which I sent you. One was a *double fountain* lamp, and in concluding the description of which, I stated that it was nearly the

Fig. 1.

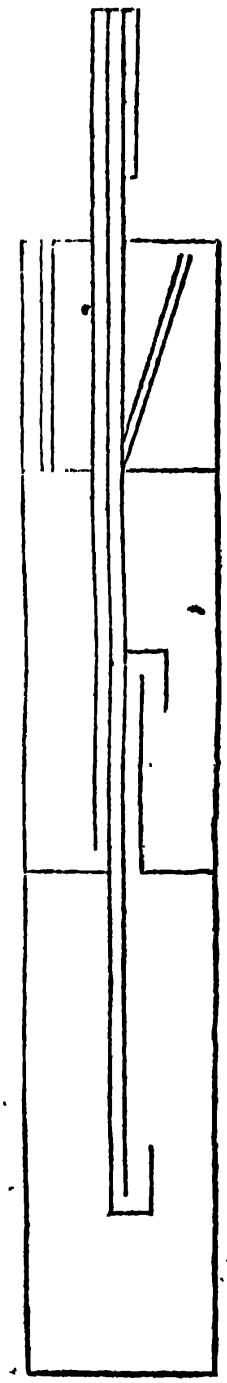
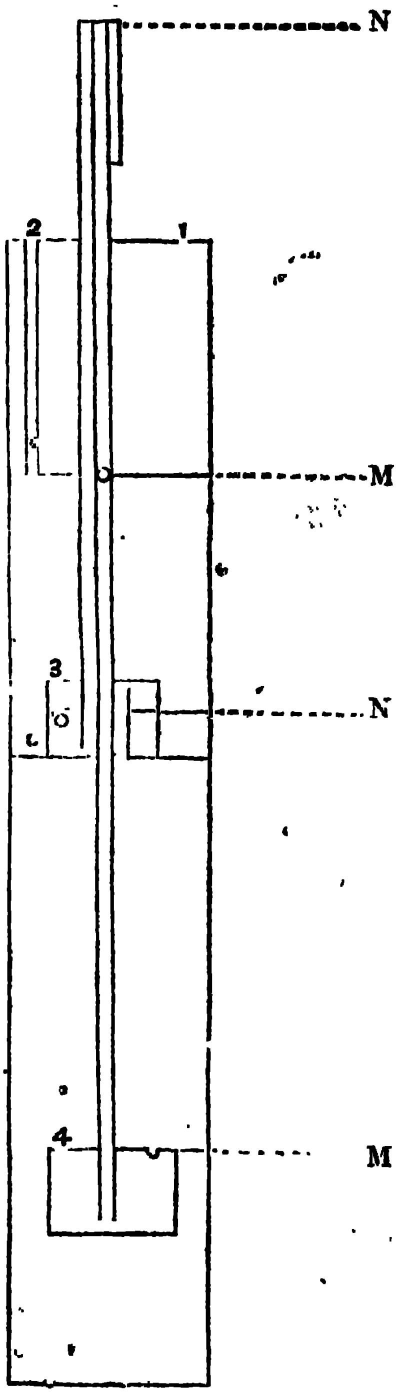


Fig. 2.




same in principle as Parker's Patent Fountain Lamp, but that the action of the latter is exceedingly imperfect. This arises not from any error in the principle, but from its being imperfectly carried out, by a faulty construction of the lamp, which prevents the end in view being obtained. Having one of these (Parker's) lamps, which I could never get to succeed, I had it altered with the view of rectifying the faults alluded to, and the result fully answered my expectation; for the action of the lamp has ever since been as steady and uniform as that of the common fountain lamp. Should any of your readers be in possession of one of these lamps, and, after fruitless efforts, have laid it aside as useless, it may be satisfactory to them to know, that with very little trouble and expense, their lamp may be rendered a very serviceable instrument for giving light, the alterations required being nothing but what any common tin smith is competent to undertake.

The form of the lamp in my possession

is that of a hollow pillar, containing a cylindrical tin case, which constitutes the lamp. Fig. 1 is a section of the tin case or lamp in its original state; fig. 2, of the same in its altered state. An inspection will show in what respects they differ, and, assisted with a short explanation, what alteration is required to render the lamp manageable and certain in its action.

The upper compartment, corresponding with the reservoir of the common fountain lamp, is to have an opening (1) at top for filling it with oil, which is to be fitted with an air-tight screw cap; the only communication it has with the external air, is by an air hole (shown by a small circle) at bottom, communicating with the centre tube, which passes down through the middle of the instrument; this communication is closed, while filling in the oil, by a valve attached to the end of a wire passing through a stuffing-box and fixed to the rack, which raises the wick. The tube (2) communicating with the middle compartment, has also an air-tight screw cap, and is so made in the patent lamps. A case, 3, encloses the lower part of the tube going up to the burner, and a short tube communicating with the lower compartment, and rising about 1½ inch higher: the only communication between this case and the middle compartment is by an air hole in its side (shown by a small circle) midway between the bottom and top of the two tubes just mentioned. The centre tube terminates near the bottom of an open box, or case (4), which is soldered to it, and has a semicircular notch or lip cut in its upper edge to cause the oil to drop over in a more steady and gradual manner. This case should be made of such capacity as to contain, without flowing over at the lip, as much oil as would fill the centre tube up to or above the air hole of the upper compartment; and there should be left sufficient space at the bottom of the lower compartment to contain the oil dropping over at the lip, as the action of the lamp becomes impaired when the oil rises above the level of the lip. Another point to be attended to, is to make M M, the distance from the air hole of the upper compartment to the lip of the case (4,) equal to N N, the distance from the air hole of case 3, to the top of the wick tube, or burner, or more usefully, to within $\frac{2}{10}$ths of an inch of the top, in order to obviate the risk of the oil flowing over by any moving of the lamp.

*To prepare the lamp for use.*—The cap 2 being taken off, pour in at the centre tube as much oil as will fill the case 4; then fill the middle compartment at 2, and screw on the cap: then, having filled the upper compartment and screwed on the cap 1, open the valve by turning the rack, and oil will descend into the centre tube until it rises to the level of the air hole; at the same time, the compression of the included air will be raising a corresponding column of oil to the burner.

*To restore the lamp after it has been used*—Invert the case, when the oil in the lower compartment will flow into, and fill the middle one, the surplus passing down the burner tube and flowing out; then return it to its right position, and removing the cap 2, pour in oil at the centre tube, until bubbles of air begin to come up through the oil in the middle compartment, and then screw on the cap again: next supply the upper compartment with oil as before.

I am, Sir, &c.

N. N. L.

December, 1812.

## ON INSTRUMENTS OF MUSIC, PLAYED BY THE FINGER AND BY MECHANICAL FRICTION.

Sir,—In a former communication on the subject of musical instruments, whose sounds are produced on the principle of the free reed, I adverted to some others which have the great advantage of their sounds being varied in power and quality by the pressure of the finger of the performer; and as this affords a capability of expression but little inferior to that possessed by the violinist, combined with the advantage of the parts being executed by one performer, I trust an examination of the construction of them, and the advantages possessed by the different methods which have been employed to effect the above purpose, may be at least bearable to such of your readers as delight in the "concord of sweet sounds."

It may be remarked, that, in nearly all the musical instruments which have been designed to have their sounds swelled by the pressure of the finger of the performer, the vibrations of the elastic body,

on which the pitch of their sounds depends, has been either excited or continued by the friction of some moving substance, acting in a similar manner to the bow of the violin; and indeed the great desideratum appears to be to contrive a substitute for a bow, which shall be capable of eliciting tones comparable to those produced by that simple contrivance in the hand of a Paganini. From the perfect swell obtained by performers on wind instruments by more forcible blowing, it would naturally be supposed that a perfect swell could be obtained in the organ by having a command over the pressure of air in the wind-chest; but, unfortunately, this puts the instrument out of tune, and we are compelled to bear with that very imperfect substitute, a swell pedal, which merely opens a box, but cannot affect the relative power of any one sound produced by the pipes within it. In the colophon, and other instruments constructed on the free reed or valve principle, a very perfect swell may be obtained by increasing the pressure of the wind, which does not materially alter the pitch; and by having an extra bellows, and two or more rows of keys, I am convinced very expressive effects may be attained. The earliest instrument of continued sound with which I am acquainted, whose sounds depend on friction, is the once common hurdy-gurdy, or *vielle*; and, however barbarous its sounds may be deemed, they are an expressive type of a rather large class of bad mechanical fiddles, which have been tried and found wanting during the last half century. In this instrument a wooden (!!) wheel or cylinder is made to rub against the strings; and, between the dead harshness of the tone produced by the "wooden" wheel, and the chattering of the strings, produced by imperfect stopping at what should be their aliquot parts, the noise is almost enough to produce a *mortification* of our auditory nerves. A monstrous hurdy-gurdy—it had a fairer name given to it, but it was one—was constructed, about ten or twelve years since, for the Italian Opera, with the *modest* intention of superseding the double basses, &c.; but from the difficulty of stopping, which was attempted by an action similar to that of the harp, and perhaps its defects of tone, it was laid aside, to the great relief of Messrs. Lindley, Dragonetti, and Co., who no doubt had a horror of the monster's "excessive competition," equalling that of Robert Owen himself.

The best mechanical fiddle ever constructed is that powerful and full-toned instrument, the claviol, or keyed violin, of my respected friend, John Isaac Hawkins, Esq., the excellence of whose tone is probably due to the construction of the wheels, or substitutes for bows, and a more scientific adjustment of the velocity of their motions to the rates of the vibrations of the strings; for it is of great practical importance, for the purpose of ensuring an equal quality of tone throughout the compass of such instruments, that the motions of the bows, or whatever is substituted for bows, should be well proportioned to the pitch of the sounds. In a compass of six octaves, perhaps, the motion of the high treble bow should be five or six times as rapid as that for the lower bass sounds. In the claviol the substitutes for bows are hoops perforated by a great number of holes, through which horse hair is passed, so that the interior surface of each hoop becomes a polygon, whose angles are very numerous.

It was a favourite theory with the mathematicians, that a circle is only that impossible bull "an infinite number" of straight lines, whose angles of intersection are infinitely small. Now, for every practical purpose, the angles formed by the crossing within the hoop are infinitely small; for, from their relative position and great number, combined with the elasticity of the hair, the ear is unable to detect any inequality of tone. This excellent contrivance, worthy its talented author, was pirated by the French for an instrument termed the orchestrina, and, like the ever-pointed pencil of the same individual, is less known to the public as the production of its inventor, than as associated with other names. The claviol has many other advantages, in particular that of standing remarkably well in tune, which is effected by protecting the gut strings from atmospheric humidity by a coating of varnish, and preserving an almost perfectly uniform force of tension, by attaching one end of each string to a very long helical spring, made of hardened and tempered steel wire. By these arrangements the pitch is prevented from undergoing any considerable variation with the extreme vari-

ations of atmospheric temperature, and the intonation is preserved almost as perfectly as if the sounds were produced by as many tuning forks.

The mention of tuning forks has reminded me that a musical instrument has been constructed, which consists of a series of such forks made to vibrate by a rosined silk band brought in contact with the prongs by means of a lever, at one end of which is a small pulley, the other being connected with the finger key. I think Mr. Goldsworthy Gurney, of steam locomotive notoriety, constructed an instrument of this kind, as well as his piano, in which heavy steel springs are substituted for strings, neither of which are much more novel than the arrangements of his steam carriage, which resembles Trevethick's, for I have seen a piano-forte of this kind thirty years old. Both instruments labour under the great defect of requiring much power to put the heavy springs into a state of vibration, which causes the bowing in one, and the blow of the other to be too much heard, a defect which does not exist when the vibrating parts are not heavier than the steel or gut strings of a piano or violin.

Nearly allied to the instrument consisting of tuning-forks is the terpodian, [illegible] that is nearly the same the œdephon; but instead of the vibrating springs being in the form of forks, they are cylindrical rods of metal, from which depend thin pieces of brass, on the fronts of which are affixed pieces of felt. The action brings the thin piece of brass, or rather its covering of felt, against a revolving cylinder of metal, or more properly a number of cylinders on one axis, whose surfaces are coated with rosin. The bowing action of the cylinders is communicated by the depending pieces of brass to rods above, causing them to vibrate. The tones thus produced are most delightful in the middle part of the compass, and the swell produced by the pressure of the finger, is perhaps superior to that of any other keyed instrument; but it is difficult to keep in order, and the quality of tone varies much at the extremities of the compass; but this I attribute to a strange error of the maker, who has put the largest cylinder to act on the bass rods, and the smallest to the treble; and all the cylinders being on the axis, the rates of motion of their surfaces are just contrary to what they should be: an evil not confined to the œdephon, for it exists to a greater degree in that delightful instrument, the harmonicon of Dr. Franklin, in which the glass bells are all fixed on one spindle or axis; and, consequently, the larger ones, which produce the bass sounds, perform the same number of revolutions per minute as the small bells which utter the highest treble, though their peripheries being so much larger, the motion of the surfaces is much quicker. This evil might be avoided by putting each octave of bells on to a separate axis, and if the axes were made tubular, and one allowed to revolve within the other, any required speed might be communicated to each, and the quality of the tone be rendered equal throughout the compass. The harmonicon is subject to the very disagreeable accident of the glass bells breaking in use, by which the fingers of the performer are liable to be severely cut, if applied directly to the glass bells. Those made to play with keys are not so dangerous, but the tone is not so good. Perhaps some of your musical readers can inform me if a harmonicon has yet been constructed with metal bells; they would possess the advantage of not being liable to fracture, and the compass might be carried lower in the bass with more facility; they would also be very easy to tune, which glasses certainly are not, as any one who has made the attempt can testify. The tone and power of expression on this instrument are so delightful that it deserves some labour should be bestowed on the attempt to diminish its defects.

When describing the claviol I ought to have mentioned what should perhaps be termed a humble imitation of that instrument, which was exhibited to the musical public under the title of euphonon. In this instrument the strings are of steel wire, excepting the bass, and they are put into vibration by an endless band, acting as a bow, one band to each string. It is less expensive in construction than the claviol, but its tone is far inferior in power and quality, and from the great number of bows or bands is more difficult to keep in order; besides, it has no contrivance for insuring a nearly equal straining force on its strings, and consequently does not stand in tune better than an ordinary piano, which it much resembles in its construction, excepting the action. Instruments of this kind, I

believe, are not very modern. I saw one ten years ago, perhaps thirty or forty years old, which was of German manufacture, but they underwent some improvements by Mr. Pinnock, and also I believe by Mr. Hawkins. In the old one, before mentioned, the bows or endless bands all moved with the same velocity, but I believe this great error was corrected in some of the more modern instruments. The same contrivance of bands or bows has been applied in America to continue the sounds of the pianoforte. — See article Piano, Herbert's Cyclopedia.

The late Mr. Walker, whose Lectures on Astronomy are amongst the memorabilia of our immediate progenitors for many years, used to perform "the music of the spheres" on an instrument he termed the celestina, and much speculation existed as to how its delicate tone was produced; but as all human secrets are in time discovered, it was found to be nothing but that much underrated instrument the harpsichord; and as the action is of easy construction, and the effects of the instrument very pleasing, I may, Mr. Editor, should you think it would be acceptable, at some future period describe it more fully for the benefit of such of your readers who, being both mechanical and musical, may desire to construct it for themselves; but the length of this communication already warns me that I must say no more at present than that it consists of an endless band of silk, rosined, which is made to rub against the strings by being brought, while in motion, between the two strings, which are turned in unison by small pullies which are affixed to the ends of levers connected with the finger-key. It is obvious that in the celestina the friction of the endless band may be used either originally to excite the vibration of the strings, or to continue their vibrations after being struck by the plectra, and of course the sound is very perfectly swelled by increasing the pressure of the finger on the key and moving the pedal quicker, having the general defect of raising the pitch thereby. This evil is very perceptible in the swell of all instruments with metal strings which are sounded by friction. The pitch of a gut string does not rise so much, but still it is sensible when the two points to which the strings are affixed are immovable. In the claviol one of these points is not absolutely fixed, it being the end of a very long helical spring, which might be stretched perhaps the twentieth part of an inch without greatly increasing the straining force. This, I believe, is the cause of the pitch of that instrument not rising when the sound is swelled to any very appreciable extent.

I feel this very long article ought to be concluded, but cannot find the heart to do so without adverting to the sostinente pianoforte of the ingenious Mr. Mott. This instrument, which combines the rapidity of the most brilliant pianoforte execution, with the power of sustaining and swelling the sounds and varying their quality at the pleasure of the performer, must, I think, stand A 1 in the scale of excellence of instruments with keys. Its power of sustaining its sound is due to an interesting fact in physical science, viz., that if an exciting cause of vibration (as for instance the action of a bow) be applied to an elastic body, the motion so imparted will be communicated to another elastic body in contact with the first. The talented inventor applied this principle by making this substitute for a bow act not immediately on the strings of the piano, but on a series of pieces of silk or hair attached to them, and by this happy thought obviated the evils which would ensue from want of elasticity in the cylinder, thereby greatly improving the tone and producing a touch which enables the fingers of the performer to do that his mind willeth to do; but I need not go into further details of the construction of this instrument, as we may congratulate ourselves on living in an age when it is procurable for love or lucre, which is not the case with the claviol, celestina, œdophon, and some others, which, like the tones of Paganini's fiddle and Malibran's voice, are heard no more in the land.

Yours most respectfully,

ALFRED SAVAGE.

16, Garlick Hill.

## COLD-BLAST ANTHRACITE IRON.

The Ystalyfera Iron Company beg to hand to the Editor of the *Mechanics' Magazine* a copy of Mr. Mushet's elaborate trials on their cold-blast anthracite iron, which they hope he will think of sufficient importance and interest to deserve insertion in his next

publication. The great experience of Mr. Mushet, and his skilful manipulations, joined to his rigorous exactness in all the conditions of comparative experiment, will, they think, remove any doubts which such an extraordinary increase in the strength and deflective power of cast-iron, as that shown by their patent elastic steel-iron might otherwise call forth.

The Ystaltera Iron Company, in placing their iron in the hands of an authority so entirely above suspicion, and so justly relied on by Mr. Crane, have given to the public all the security in their power against error or exaggeration.—*Ystalyfera, Dec.* 2.

*Experiments made with the Cold-blast Anthracite Pig-iron, manufactured at Ystalyfera Iron Works.*

BY D. MUSHET, ESQ., M.I.C.E.
Author of "Papers on Iron and Steel."

*Breakage of sundry bars of cast-iron, at two feet leverage, made with anthracite and cold-blast.—Bars 1 3-10th inches broad, ·65 inches deep.*

| | | |
|---|---|---|
| 1. No. 2 pig-iron, from No. 4 blast-furnace | lbs.. | 182½ |
| 2. Ditto ditto ditto | .. | 195½ |
| 3. Ditto ditto ditto | .. | 193½ |
| Average breaking weight | lbs. | 190½ |
| 1. No. 1 pig-iron, from No. 1 furnace | | 209½ |
| 2. Ditto ditto ditto | | 195 |
| Average breaking weight | lbs.. | 202½ |
| 1. No. 3. pig-iron, made from blast-furnace No. 1 | .. | 247½ |
| 2. Ditto ditto ditto | .. | 210½ |
| 3. Ditto ditto ditto | .. | 205½ |
| 4. Ditto ditto ditto | | 182½ |
| Average breaking weight | lbs. | 218½ |
| 1. No. 2 pig-iron, cast from No. 2 blast-furnace | | 200½ |
| 2. Ditto ditto ditto | | 227 |
| 3. Ditto ditto ditto | | 239½ |
| Average breaking weight | | 222½ |

GENERAL AVERAGE.

| | lbs. |
|---|---|
| No. 2 pig-iron, from No. 1 furnace.. | 190½ |
| No. 1 pig-iron, from No. 1 furnace.. | 202½ |
| No. 3 pig-iron, from No. 1 furnace.. | 218½ |
| No. 2 pig-iron, from No. 2 furnace.. | 222½ |
| General average of breaking weight of cast-iron from the blast furnaces lbs. | 208½ |
| Breaking average of the whole of the Yniscedwyn blast-furnace iron .. lbs. | 152 |
| Of the stone coal furnace iron.... | 170¾ |

*Breakage of sundry bars of cast-iron, remelted from pig, at a 2 feet leverage.—Bars 1 3-10th inches broad, and ·65 inches deep, as before.*

No. 2 pig-iron, made from No. 1 furnace, and remelted in the cupola with anthracite coal.

| | | |
|---|---|---|
| 1. Bar broke with... | ...lbs.. | 285¾ |
| 2. Ditto .. | ... .. | 245½ |
| 3. Ditto .. | ... .. | 263½ |
| Breaking average of cupola iron | lbs. | 264¾ |

No. 1 pig-iron, remelted in air-furnace.

| | | |
|---|---|---|
| 1. Bar broke with | lbs.. | 241 |
| 2. Ditto | .. | 211 |
| 3. Ditto | .. | 226 |
| Breaking average | lbs.. | 236 |

No. 2 pig-iron, remelted in air furnace.

| | | |
|---|---|---|
| 1. Bar broke with | lbs.. | 233 |
| 2. Ditto | .. | 233 |
| 3. Ditto | .. | 226½ |
| Breaking average | lbs.. | 230½ |

No. 3 pig-iron, remelted in air-furnace.

| | | |
|---|---|---|
| 1. Bar broke with | lbs.. | 233 |
| 2. Ditto | .. | 237¾ |
| 3. Ditto | .. | 245½ |
| 4. Ditto | .. | 217 |
| Breaking average | lbs.. | 233¾ |
| Air-furnace, No. 1, as above.... | .. | 236 |
| Ditto No. 2 ditto .... | .. | 230½ |
| Ditto No. 3 ditto .... | .. | 233 |

| | |
|---|---|
| General average of air-furnace iron lbs. | 233 |
| Ditto remelted in cupola | 264¾ |
| Ditto from the blast-furnace | 208½ |

| | | |
|---|---|---|
| Air-furnace iron stronger than blast-furnace | lbs.. | $24\frac{1}{2}$ |
| Remelted cupola iron stronger than ditto | .. | „ $56\frac{1}{4}$ |
| The average of Yniscedwyn iron remelted in cupola was | .. | $209\frac{1}{2}$ |

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*Cast-iron bars deflected and broken, made from No. 2 pig-iron, cast from No. 1 blast-furnace, with anthracite and cold-blast.—Bars* 1 3-10*th inches by* ·65.

| Length of bars 3 ft. 1 in. Supports at 2 ft. 9 in. | Breaking weight. lbs. | Deflection. inches. | Permanent set. inches. |
|---|---|---|---|
| 1. Bar, No. 2 pig-iron, from No. 1 furnace | 5221 | 1·050 | ·075 |
| 2. Ditto ditto ditto | 483 | ·900 | ·050 |
| 3. Ditto ditto ditto | 503 | 1·050 | — |
| Breaking average | 503 | | |
| 1. Bar, No. 1 pig-iron, from No. 1 furnace. | 524 | 1·200 | — |
| 2. Ditto ditto ditto | 568 | 1·100 | — |
| Breaking average | 546 | | |
| 1. Bar, No. 2 pig-iron, from No. 1 furnace. | $521\frac{3}{4}$ | ·95 | — |
| 2. Ditto ditto ditto | $705\frac{1}{4}$ | 1·150 | — |
| 3. Ditto ditto ditto | $641\frac{1}{4}$ | 1·400 | — |
| Breaking average | $631\frac{1}{2}$ | | |
| 1. Bar, No. 2 iron, from No. 1 furnace, remelted in cupola with anthracite | $594\frac{3}{4}$ | 1·40 | — |
| 2. Ditto ditto ditto | $711\frac{1}{4}$ | 1·30 | — |
| 3. Ditto ditto ditto | $715\frac{3}{4}$ | 1·60 | — |
| Breaking average | 675 | | |
| 1. Bar, No. 1, iron, remelted in air-furnace | $619\frac{1}{4}$ | 1·00 | — |
| 2. Ditto ditto ditto | $653\frac{1}{4}$ | 1·15 | — |
| 3. Ditto ditto ditto | $668\frac{1}{4}$ | 1·05 | — |
| Breaking average | $646\frac{3}{4}$ | | — |
| 1. Bar, No. 2 iron, remelted in air-furnace | $590\frac{1}{4}$ | 1·05 | — |
| 2. Ditto ditto ditto | $583\frac{1}{2}$ | 1·00 | — |
| 3. Ditto ditto ditto | $612\frac{1}{2}$ | 1·20 | — |
| Breaking average | $595\frac{1}{2}$ | | |
| 1. Bar, No. 3 iron, remelted in air-furnace | 669 | 1·10 | — |
| 2. Ditto ditto ditto | $704\frac{3}{4}$ | 1·20 | — |
| 3. Ditto ditto ditto | $682\frac{1}{4}$ | 1·05 | — |
| 4. Ditto ditto ditto | 639 | 1·05 | — |
| Breaking average | $682\frac{1}{4}$ | | |
| 1. Bar, No. [illegible] pig-iron, from No. 1 furnace | $580\frac{3}{4}$ | 1·00 | — |
| 2. Ditto ditto ditto | 554 | [illegible] | — |
| 3. Ditto ditto ditto | 640 | 1·30 | — |
| Breaking average | $591\frac{1}{2}$ | | |

| General average of blast-furnace iron. | | | General average of the remelted iron. | | |
|---|---|---|---|---|---|
| First Breakage | lbs.. | 503 | First breakage | lbs.. | 675 |
| Second ditto | .. | 546 | Second ditto | .. | $646\frac{3}{4}$ |
| Third ditto | .. | $631\frac{1}{2}$ | Third ditto | .. | $595\frac{1}{2}$ |
| Fourth ditto | .. | $591\frac{1}{2}$ | Fourth ditto | .. | $682\frac{1}{4}$ |
| Breaking average | lbs.. | 568 | Breaking average | lbs.. | $649\frac{3}{4}$ |

*Breakage of cast-iron bars, 5 feet 1 inch long and 1 inch square—distance between supports 4 feet 6 inches.*

| | Breaking weight. lbs. | Deflection. inch. | Set. inch. | Force to resist impact. |
|---|---|---|---|---|
| **No. 2 iron, from No. 1 blast-furnace.** | | | | |
| 1. Bar, broke with | 650¾ | 2·05 | — | 1396 |
| 2. Ditto ditto. | 608¾ | 1·80 | — | 1095 |
| 3. Ditto ditto | 608¾ | 1·95 | ·175 | 1187 |
| Average | 622¾ | 1·933 | | |
| **No. 2 iron, from No. 2 blast-furnace.** | | | | |
| 1. Bar broke with | 587¾ | 1·80 | — | 1057 |
| 2. Ditto ditto | 594 | 1·90 | — | 1128 |
| Average | 590¾ | 1·850 | | |
| **No. 2 iron, from hot-blast furnace.** | | | | |
| 1. Bar broke with | 634¾ | 2·10 | — | 1332 |
| 2. Ditto ditto | 629¾ | 2·10 | — | 1322 |
| 3. Ditto ditto | 661¾ | 2·35 | — | 1565 |
| Average | 642 | 2·183 | | |
| **No. 2 iron, remelted in cupola with anthracite.** | | | | |
| 1. Bar broke with | 650¾ | 1.95 | — | 1268 |
| 2. Ditto ditto | 577 | 2·05 | — | 1495 |
| 3. Ditto ditto | 692¾ | 2·00 | — | 1357 |
| Average | 674 | 2·03 | | |
| **No. 1 iron, re-melted in air-furnace.** | | | | |
| 1. Bar broke with | 603¾ | 1·60 | — | 966 |
| 2. Ditto ditto | 577 | 1·50 | — | 865 |
| 3. Ditto ditto | 689¾ | 1·90 | — | 1310 |
| Average | 676½ | 1·66 | | |
| **No. 2 iron, re-melted in air-furnace.** | | | | |
| 1. Bar broke with | 617¼ | 1·70 | — | 1049 |
| 2. Ditto ditto | 583 | 1·60 | — | 932 |
| 3. Ditto ditto | 612¼ | 1·90 | — | 1164 |
| Average | 604¼ | 1·733 | | |
| **No. 3 iron, remelted in air-furnace.** | | | | |
| 1. Bar broke with | 657 | 2·00 | ·15 | 1314 |
| 2. Ditto ditto | 732 | 1·90 | ·15 | 1390 |
| 3. Ditto ditto | 731 | 1·95 | ·20 | 1425 |
| 4. Ditto ditto | 676½ | 1·70 | — | 1150 |
| Average | 699 | 1·888 | | |
| **No. 2 pig-iron, cast from No. 1 blast-furnace.** | | | | |
| 1. Bar broke with | 696¾ | 2·40 | — | 1672 |
| 2. Ditto ditto | 672¾ | 2·10 | — | 1412 |
| 3. Ditto ditto | 622¾ | 1·70 | — | 1038 |
| 4. Ditto ditto | 594¾ | 2·00 | — | 1189 |
| Average | 646 | 2·05 | | |

ABSTRACT OF AVERAGES.

| | | | | |
|---|---|---|---|---|
| 3 bars, No. 2 pig-iron, from blast-furnace No. 1. | 622¼ | 1·933 | — | 1203 |
| 2 ditto, No. 2 ditto, from ditto No. 2 | 590¾ | 1·850 | — | 1092 |
| 3 ditto, No. 3 ditto, from ditto No. 1 | 642 | 2·183 | — | 1101 |
| 3 ditto, No. 2, remelted in cupola | 674 | 2·033 | — | 1374 |
| 3 ditto, No. 1, ditto in air furnace | 676⅓ | 1·660 | — | 1122 |
| 3 ditto, No. 2, ditto ditto | 604¼ | 1·733 | — | 1047 |
| 4 ditto, No. 3, ditto ditto | 699 | 1·888 | — | 1319 |
| 4 ditto, No. 2 iron, from No. 1 blast-furnace | 646 | 2·050 | — | 1324 |
| | 644¼ | 1·916 | | 1235 |

ABSTRACT OF TREDGOLD'S EXPERIMENTS.

*At a breaking leverage of 2 feet, to compare with the Ystalyfera iron.—Bars 1 3-10th inches by ·65.*

| | |
|---|---|
| Old Park iron broke with .. lbs.. | 181 |
| Adelphi ditto ditto | 173 |
| Alpelono ditto ditto | 153 |
| Scrap ditto ditto | 168 |
| Mixture of Old Park and scrap, or old iron .. lbs.. | 174 |
| | 852 |
| Average of the whole .... lbs.. | 170 2·5 |
| Average of the Ystalyfera blast-furnace iron .... lbs.. | 208 3·5 |
| Difference .... lbs.. | 38 |

—equal to 22½ per cent.—To this extent the iron from the Ystalyfera blast furnaces is stronger than the remelted iron of Tredgold.

| | |
|---|---|
| Average breaking weight of the Ystalyfera iron remelted in the air-furnace .... | 233 |
| Tredgold's average of remelted iron | 170 2·5 |
| Ystalyfera iron stronger by lbs. | 62 3 5 |

—equal to 36½ per cent.

| | |
|---|---|
| Average breaking weight of the Ystalyfera iron, remelted in cupola with anthracite .... lbs. | 269¾ |
| Tredgold's average .... | 170 2·5 |
| Ystalyfera iron stronger by lbs. | 99 |

—equal to 58 per cent.

| | |
|---|---|
| Ystalyfera pig-iron, remelted in cupola, as above .... lbs... | 269¾ |
| Yniscedwyn iron remelted in cupola | 209½ |
| Ystalyfera iron stronger by lbs. | 60¼ |

—equal to 28 7-10th per cent.

N.B.—At the time that the strength of the Yniscedwyn iron was tried by me, it was found to be the strongest iron in England; since that period, four years ago, I am informed the strength has been considerably increased.

*Comparison between the strength and deflection of the Ystalyfera iron, made with cold-blast and anthracite, and those experiments made with the same iron, manufactured with hot-blast.—Bars 5 feet long 1 inch square; the supports 4 ft. 6 inches apart.*

| | Breaking weight. |
|---|---|
| Ystalyfera cold-blast iron, from furnace .... lbs.. | 618½ |
| Ditto hot-blast iron, remelted as per Mr. Evans's second table of experiments .... lbs.. | 496 |
| Cold blast stronger from furnace .... lbs.. | 122½ |

—equal to 24 6-10th per cent.

| | Deflection. |
|---|---|
| Ystalyfera cold-blast iron, from furnace .... lbs.. | 1·988 |
| Ditto hot-blast, remelted by Mr. Evans .... | 1·632 |
| Difference .... lbs.. | ·356 |

—equal to 21 8-10th per cent.

| | Force to resist impact. |
|---|---|
| Ystalyfera cold-blast iron, from furnace .... lbs.. | 1297 |
| Ditto hot-blast, remelted by Mr. Evans .... | 821 |
| Difference .... lbs.. | 476 |

—equal to 57 9-10th per cent.

| | Breaking weight. |
|---|---|
| Ystalyfera cold-blast iron, remelted in cupola with anthracite .... lbs.. | 674 |
| Ditto hot-blast iron, remelted by Mr. Evans .... | 496 |
| Difference .... lbs.. | 178 |

—equal to 35 8-10th per cent. in favour of cold-blast.

| | Deflection. |
|---|---|
| Ystalyfera cold-blast iron, remelted in cupola ........................ lbs.. | 2·030 |
| Ditto hot-blast, remelted by Mr. Evans ........................... | 1·632 |
| Difference........................................ lbs.. | ·398 |

—equal to 24 3-10th per cent. in favour of cold-blast.

| | Force to resist impact. |
|---|---|
| Ystalyfera cold-blast iron, remelted in cupola ...................... lbs.. | 1373 |
| Ditto hot-blast, remelted by Mr. Evans .............................. | 811 |
| Difference........................................ lbs.. | 562 |

—equal to 69½ per cent. in favour of cold-blast.

| | Breaking weight. |
|---|---|
| Ystalyfera cold-blast iron, remelted in air-furnace .................. lbs.. | 660 |
| Ditto hot-blast, per Mr. Evans ................................. lbs.. | 496 |
| Difference........................................ lbs.. | 164 |

—equal to 33½ per cent. in favour of cold-blast.

| | Deflection. |
|---|---|
| Ystalyfera cold-blast iron, from air-furnace ........................ lbs.. | 1·760 |
| Ditto hot-blast, per Mr. Evans ...................................... | 1·632 |
| Difference........................................ lbs.. | ·128 |

—equal to 8 per cent. in favour of cold-blast.

| | Force to resist impact. |
|---|---|
| Ystalyfera cold-blast iron, from air-furnace ........................ lbs.. | 1162 |
| Ditto hot-blast, per Mr. Evans ...................................... | 811 |
| Difference........................................ lbs.. | 351 |

—equal to 43¼ per cent. in favour of cold-blast.

N. B.—I have, to avoid prolixity, taken the middle table of Mr. Evans for reference, as the nearest approach to a correct mean of the qualities of the iron operated on—viz., Nos. 1, 2, and 3. His summary is—

| | Breaking weight. | Deflection. | Impact. |
|---|---|---|---|
| Table of No. 1 experiments .............. | lbs. 444½ | 1·834 | 821 |
| Ditto No. 2 ditto .................. | 496 | 1·632 | 811 |
| Ditto No. 3 ditto .................. | 533 | 1·640 | 916 |

Having clearly established the superior strength of the Ystalyfera pig-iron, made with cold-blast, more particularly in reference to the experiments of Mr. Tredgold and those of Mr. Evans, I have next abstracted Mr. Fairbairn's Table of General Results, and, as nearly as possible, arranged and divided them into two classes—viz., Experiments with Hot-blast Iron, and Experiments with Cold-blast Iron.—The abstract of results of the hot-blast iron I find to be as follows:—

| | |
|---|---|
| Average breaking weight of the five feet bars, the supports being 4 ft. 6 in. apart.. lbs. | 445 |
| Average deflection ................................................ | 1·537 |
| Strength to resist impact.......................................... | 690 |
| Cold-blast—breaking weight................................ lbs. | 455 |
| „ average deflection ........................................ | 1·612 |
| „ strength to resist impact.................................. | 734 |

These results enable me to make the following comparisons:—

| | |
|---|---|
| General average of the Ystalyfera cold-blast, five feet bars, in breaking weight.. lbs. | 644½ |
| Breaking weight of similar bars, hot-blast, from Mr. Fairbairn's table .......... | 445 |
| Ystalyfera iron stronger by ........................... lbs. | 199½ |

—equal to 44 7-10th per cent.

As there is only 10 lbs. between the breaking weight of the cold and hot-blast in Mr. Fairbairn's table, any separate statement of the fact I consider unnecessary.

| | |
|---|---|
| Ystalyfera cold-blast—average deflection of the five feet bars .............. lbs. | 1·916 |
| Deflection of hot-blast iron from Mr. Fairbairn's table ........................ | 1·537 |
| Difference in favour of Ystalyfera iron .................. lbs. | ·379 |

—equal to 26 6-10th per cent.

| | | |
|---|---|---|
| Ystalyfera cold-blast—average deflection | lbs. | 1·916 |
| Deflection of cold-blast iron from Mr. Fairbairn's table | | 1·612 |
| Difference in favour of Ystalyfera iron | lbs. | ·304 |

—equal to 18 8-tenth per cent.

| | | |
|---|---|---|
| Ystalyfera cold-blast iron, in respect to its resisting impact, general average of five feet bars | lbs. | 1235 |
| Hot-blast iron from Mr. Fairbairn's table | | 690 |
| Difference in favour of the Ystalyfera iron | lbs. | 545 |

—equal to 79 per cent.

| | | |
|---|---|---|
| Ystalyfera cold-blast iron, in respect to its capacity to resist impact | lbs. | 1235 |
| Cold-blast iron from Mr. Fairbairn's table | | 734 |
| Difference in favour of the Ystalyfera iron | lbs. | 501 |

—equal to 68 2-10th per cent.

From these, and the former comparative experiments, it is abundantly evident that the pig-iron, now making with cold-blast and anthracite, at the Ystalyfera Iron Works, greatly exceeds, in strength and deflective powers, and capacity to resist impact, any iron at this time manufactured in the United Kingdom. It now only remains for me to mention a property peculiar to the iron, which was noticed at the time I made the trial experiments at Yniscedwyn, four years ago, but which has been more fully developed in those recently made at Ystalyfera. The property referred to is one of great springiness, or elasticity, which communicates a tendency to the bar, in deflecting and breaking, to resume its rectangular form. Bars that had obtained a permanent set of 2-10ths, when afterwards broken, presented but a slight deviation from a right line; and in no case did the acquired curvature exceed one-fourth of a tenth. It was also remarked, that most of the fractures, in breaking, presented a regularity of grain throughout, resembling the structure of unhardened steel.

DAVID MUSHET.

Coleford, Nov. 18.

## BLAXLAND'S PROPELLER.

Sir,—It was only this day I learnt from a friend that Mr. Elijah Galloway, C.E., in a work on "the Archimedean screw and other submarine propellers,"—(we shall some day, I presume, have a numismatic writer publishing an account, in imperial quarto, of the sixpence, or the silver penny)—has been pleased to say, the shades of Mendez Pinto, and of the Lord of Campoli, hovering over and directing his pen—that the screw-propelled "steam-ship," on a certain occasion, ran with the *Swiftsure*, and ran round her.

The truth is as follows. On the 6th of June, the *Swiftsure* quitted her moorings at Greenwich, and went down the river, for the purpose of adjusting her new ropes. As she passed Blackwall, the said "steam-ship," called, I believe, the *Novelty*, (why not "Wimshurst's Folly?") then lying there with her steam up, started for the purpose, as was afterwards seen, of running with her. Upon the *Swiftsure's* reaching Erith, she turned, and met the *Novelty* worming her way by Half-way Reach. The latter turned about, and from thence, as far as Blackwall Reach, endeavoured to overhaul her, till then, unconscious antagonist. "*Hac magno cursu contenderunt*," and at Blackwall Reach the *Novelty* came alongside the *Swiftsure* for a few seconds, but there falling far astern, for the fifth or sixth time, she tacked about the distance from the Reach to Greenwich, being too little for another *shool*. The *Swiftsure*, during this last run, was compelled to slacken once, for full ten minutes, that the tightening-screws of her ropes might be put on, and no more than 32 of her 40 horses' power, (*low* pressure,) owing to the newness of the ropes, could, on an average, be employed.

The tide against the vessels, on their return, was taken at two miles; but the "steam-ship" being fully rigged, it was considered the strong wind in favour balanced her account with it. The singular irregularity of her speed—evidencing that many times her feed-pumps were shut off, for the purpose of keeping her steam in her boiler—was remarked, as was the extreme blue of her exhaust steam, denoting the enormous pressure upon it. Her mode of steaming resembled much the progress of the Gyrinus (water flea).

What the speed of the *Novelty* may be, ($7\frac{1}{2}$ miles in her advertisement for sale,) and what the speed of the *Swiftsure*, we are not

here called upon to inquire. The relative speeds of the Archimedean screw and of Mr. Blaxland's propeller—the target fired at—are at this very time being tried by Government.

Such are the facts—"*Perspecta et explorata sunt, quæ scribo.*"

Yours, &c.,

C.

P.S.—It may not be quite uninteresting to your readers to be informed that the *Little Jane*, whose extraordinary performances you have recorded, has been now some time in the service. She is the pinnace to the *Salamander*, from off which frigate she is destined to land the British Ambassador, the Right Hon. Henry Ellis, at Rio.

November 28, 1842.

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DOMESTIC FIRES AND KING'S STOVE GRATE.

Sir,—Your correspondent, "T. H. B.," (with whose *style* I somehow fancy myself acquainted, although I do not remember his *signature*,) seems (p. 494) to have been so very anxious to dispute the few remarks upon combustion which I took the liberty of sending you, and to which you were kind enough to afford a place in your columns, that he almost forgot to ascertain what the remarks themselves were, and to what they applied: how far he apprehended their object appears from his assertion, that I complain that, from the escape of unconsumed gas in common grates, "heat is lost;" my remarks having had regard altogether to the prevention of *smoke*, without at all referring to the loss of *heat*, or any means of saving it. I may now add, that I consider the latter an insignificant desideratum, when compared with the former; in reference, of course, to the consumption of fuel in *a large city*.

The importance of this subject is well contended for in the extract from Mr. Curtis's work on "The Preservation of Health," which appeared in the same Number of your Magazine as your correspondent's letter: and undoubtedly, the recommended general adoption of Mr. Williams's "argand furnace" in all London manufactories would greatly abate the smoke nuisance, but I fear that we can scarcely expect thus to remove it entirely; for it must be allowed that the enormous quantity of smoke generated in the innumerable domestic hearths throughout "the great Metropolis," would be of itself sufficient to constitute a very injurious degree of impurity in the atmosphere, as well as a very *visible* fog. This consideration it was that suggested the remarks in question.

The difference which we sometimes perceive between the combustion at the front of the grate and at the back, I referred to want of air, and with reason I am inclined to think, as the supply of air in the latter situation is far inferior to that in the former, and the heat in both must be nearly alike.

Your correspondent, however, contends (apparently, for he does not express himself very clearly) that this is owing to want of heat, and I can assure him I have no wish to disturb his opinion, or commence a dispute on such a trivial subject, it being, besides, one upon which it were impossible to arrive at anything like demonstration; of course *he* would greatly respect a *mathematical* proof.

My recommendation, that the back of the grate should be assimilated somewhat to the front, so as to admit air, is construed by your correspondent into a detailed suggestion on my part, that it should be "perforated with holes;" this plan, though rather in a crude state, I am, however, willing to adopt as far preferable to the *corrugated* back, whose virtues are lauded by your correspondent. I cannot, however, subscribe to the supposition that it is useless, (with regard to its heat-giving power) to have the back of the fire as brilliant as the front, still less to the *original* idea, that "at the same expense, more heat will be obtained by keeping a large fire, bright in front, but black behind;" both which rest on the erroneous notion, that the heat thrown out by a fire depends upon the heat *in the front merely*, and not upon the actual quantity of heat in *the whole fire*, the latter being the real source from which to estimate the heating effect; for we find that the heat thrown out by a furnace through its door, depends as much upon the size and heat of the furnace, as upon the size of the door. Moreover, the heat transmitted to the wall cannot be considered as lost, any more than the power transmitted by any kind of machinery, for it all comes into play again, being diffused through the wall, and in this manner expended in warming the rooms at each side.

Your correspondent's plan for a stove-grate will be considered, I should expect, too unseemly an excrescence in a room to be generally adopted; although, perhaps, it may be a medium between the *stove* method of warming a room, by communication and heating the air in it, and the more peculiarly English method, *radiation;* which, permitting us while comfortably warm to enjoy a comparatively cold and fresh atmosphere, seems too firmly fixed in use in this country to be easily changed,—an Englishman at once perceiving an unpleasant closeness in a room warmed by a stove, (without much draught), even though it be kept at

only a moderate heat, as those of the Arnot tribe usually are.

I am, Sir, your obedient servant,

R. W. T.

*Postscript.*

Sir,—Perhaps you will permit me to add a postscript to my letter already forwarded, as I have just seen the account of Mr. King's stove in your last Number (No. 1009).

The introduction of this subject seems to have produced a *combustion* among the stove-loving part of your readers. I hope that it may not, like the imperfect one deprecated, *end in smoke*.

I can easily believe that Mr. King's stove carries out my view, more than J. H. B.'s does; but it does not come up to my *beau ideal* of an anti-smoke grate, and differs very considerably from one I was about planning a short time ago, but which I have not had leisure to finish, as the details require much consideration, as well as experimental examination of the subject. This, however, is a case in which nearly the same end may possibly be arrived at by apparently differing means. And, besides, it is *very little* matter whether my suggestions are carried out or not in Mr. King's stove, if it is a good consumer. I am sure his *conductor* would be an excellent addition to most grates, and probably go far to cure a smoking chimney, although it might, perhaps, sometimes be the means of originating a *puff*.

I am, Sir,

Your obedient servant,

R. W. T.

DOUBLE REVOLUTION STEAM-ENGINES—BUNNETT'S CONCENTRIC ENGINE.

Sir,—Your correspondent, Mr. Thomas Rolls, who sends you a sketch of a "Double Revolution High Pressure Steam-engine," (described at page 514,) states that he considers it "perfectly new," and *to him* I have no doubt it is so.

I think it right, however, to state that the "double revolution" part of the affair, forms one of the "Improvements in Steam-engines," for which letters patent were granted to "Joseph Bunnett, of Deptford, Engineer," in June 1838! Mr. Rolls must be content therefore, to forego the "obvious advantages" of his invention, though what he supposes these advantages to be, is not stated. His vibratory engine consists of an arrangement that has been invented, re-invented, and patented, some score of times, but has never yet been found to realize in practice any very "obvious advantages."

Bunnett's Concentric Steam-engine, to which the "Double Revolution" movement was applied, has been found in use to realize all the advantages ever claimed for the semi-rotative class, without entailing any of their numerous defects. A description of this engine was published in your 31st volume, page 210, and an engine of this description has been in daily use for the last four years at the patentee's works at Deptford, where it may be seen in operation by any person who feels an interest in the matter.

The "Cambrian Oscillating Engine," described at the commencement of the present volume, in its *action* bears a striking resemblance to Bunnett's concentric engine, but a comparison of the two will show that there is a wide and important difference between them,

I am, Sir,

Yours respectfully,

WM. BADDELEY.

29, Alfred-street, Islington.
December 7, 1842.

RAILWAY REFORM.*

Some more killing and breaking of bones, and, as the customary sequel, *a little more reform*. It would almost seem as if the Companies habitually resisted *to the killing point* all improvement, in order that they may have the adoption of some universally called for alteration of system, to set off against each fatal accident as it occurs—to reconcile the public, as it were, to the disaster of the moment, by the reflection that it has brought about a change which will make railway travelling all the safer for the future.

The accident to which our attention is at present called, is one on the Birmingham line, by which one person has been killed, and three others seriously wounded. It was caused by the overturn of the engine, through the breaking of the front axle, and that engine a FOUR-wheeled one, *with inside bearings*—the very sort of carriage which the Birmingham Company, its officers, and its engine builders, have of late been striving so hard to persuade the public is incapable of being overset from any such cause—so much so, that it could run almost as well with an axle sawn through, as entire.

Mr. Parker, the foreman of Messrs. Bury, Curtis and Kennedy, the engine builders to the Company, in his evidence at the coro-

ner's inquest on the body of the person killed, asserted that the accident would have equally occurred if the engine had been one with six wheels. He cannot seriously expect the public to believe this. He must have meant what he said *with a reservation;* such as, that the six-wheeled engines he referred to were those of the old and still common form, with *outside* bearings. He certainly could not mean to say, that the risk of oversetting would not have been greatly diminished if the engine had been on *six* wheels, with *inside* bearings, on the same judicious plan on which the four-wheeled engines made by his firm are constructed, and for the first introduction of which they deserve all the credit which they claim. (See Circular of Messrs. Bury, Curtis, and Kennedy, in *Mechanics' Magazine*, No. 1006, and also the letter from the firm, in our present Number.) Our own firm belief is, that, had the engine been one of this description, there would have been no oversetting, and no damage from *that cause*, at least.

But there is another danger, besides oversetting, likely to result from the breaking of an axle. The sudden stoppage of the engine of a train going at the rate of between 25 and 30 miles an hour, (the rate at which the one in question was going,) is certain, if it remain on the line, to cause a crushing collision between it and the first carriage behind (and perhaps second) so as to make the latter swerve from the line, at the risk, in some cases, of being dashed against an adjacent wall of rock or earth, or, in others, of being thrown over a high embankment; and, as regards this sort of accident, it matters nothing whether the engine is on four wheels or on six. An absolute remedy for it there may be some difficulty to find; but all mortal harm from it can always be averted by carrying nothing in the first and second carriages next to the engine but goods or luggage. Many accidents have happened, as well from such direct collisions, as from engines turning over to one side, to the *first* carriages of trains, and many have been the lives destroyed by them; but very rarely has a second carriage been injured in either way, and never once (we believe) any carriage stationed farther to the rear. Often and often have the railway companies been urged to adopt this obvious plan of protection; but, until just now, with only very partial success. When crowned heads have had occasion to travel by railway, the plan has been invariably adopted (killing a sovereign being, it would seem, more than they chose to run the risk of); but the vulgar million most of the companies have persisted in carrying as before, in close proximity to the engine. At length the melancholy accident which has called for these present remarks occurs, and Mr. Bury, in giving evidence respecting it before the coroner, is obliged to make this explicit admission—

"*An empty carriage or van, interposed between the engine and carriages, in this instance would have prevented the accident,*" (i. e. the death of the person killed.)

Mr. Bury is naturally asked by the coroner—

"Admitting then, as you of course do, its safety, why do you not adopt this plan? Are there any objections to it?"

And he answers—

"There are objections to it. The matter has been a subject of great discussion, and I believe the company will now adopt the plan. *Experience points out the necessity of doing something of the sort;* yet there may be circumstances in which a truck or van, placed between the engine and carriages, would produce serious accidents."

What "circumstances?" We have heard before of such "circumstances," but always in so vague and mysterious a way, that we never could make any thing tangible of them. We cannot, ourselves, imagine any class of circumstances whatever, and do not believe that any such can ever exist, under which any serious accident could possibly arise from the interposition of a luggage van or two between the engine and passenger carriages—that is, accidents involving loss of life or personal injury, of which alone we speak, and about which alone the public have any anxiety.

The jury found a verdict of "Accidental death," with a deodand of *only* 5*s.* on the engine; but accompanied their verdict by a

recommendation to the railway company, "to place for the future an empty carriage, or luggage van, between the engine and the passenger carriages." Whereupon, Mr. Creed, the secretary to the company, announced that "*The company had already determined upon adopting the plan suggested by the jury.*"

And thus, gentle reader, is the *little more reform* which we spoke of in the outset as being the consolatory result of the little more killing and bone-smashing.

The four-wheel system, which was the primary cause of the accident, is still, for some time longer, to be adhered to on the Birmingham line, in spite of the many proofs which experience has furnished of its tendency to produce such accidents, and in spite of public opinion, often and most unequivocally expressed, on the subject; but the dangers attending it are to be henceforth so far diminished, that when axles next break, and engines next tumble over embankments, there shall be one luggage van, at least, between them and the passengers. *Two* would be better; but that would have been too much to hope for at once, at the hands of such slow-going, bit-by-bit reformers. Let us be thankful that one step has been gained, as long as it is one so much in the right direction. We have but to wait for a few more such *innocent* illustrations as we have just had of the *infallibility* of the four-wheel system, and we may safely reckon on that, too, being ultimately classed among the exploded errors of a bygone time.

## THE ACCIDENT ON THE VERSAILLES RAILWAY.—ACTION FOR DAMAGES.

The important trial arising out of the awful railway accident of the 8th of May last, and which, in fact, is a grand inquest taken on the causes and consequences of this lamentable event, commenced on the 22nd Nov., and was continued *de die in diem* until Dec. 3. The Chamber de Conseil having, after mature consideration of the previous examinations, declared that there were no grounds for including the Council of Administration of the Company of the Paris and Versailles Railroad (Left Bank) in the prosecutions, decided that M. Jules Bourgeois, Administrateur délégué; M. Bordet, Provisional Director; M. Henri, Chief of the Paris Station; M. Bricogne, Civil Engineer, Directeur du Matériel; M. Lamoninare, Chief of the Station at Versailles; and M. Milhau, Inspector of the Service, should be arraigned as guilty of homicide through imprudence. The act of accusation, or indictment, gave a full and minute recapitulation of all the disastrous circumstances attending the accident, enumerating the persons who became its victims, either by loss of life or severe mutilation. The points of accusation insisted upon by the prosecution were—the insufficiency of the number of engines for the service of the road, so as not to allow time enough between their respective journeys to be properly inspected and repaired, when requiring repair; the unfitness of the four-wheel engine, the Matthew Murray; the want of judgment and prudence in placing it before the Eclair, a six-wheel engine of much greater force; and, lastly, the imprudence of running the train with too great velocity, whereby the accident was caused. On the question of the fitness of the Matthew Murray, the testimony was various and contradictory. It certainly appeared from the evidence that its peculiarities required a skilful conductor, but it was declared, that with such conductor it was an effective machine. On the subject of the opinion of George, who guided it on the 8th of May, and who was among those who lost their lives on that day, who also is acknowledged by every one to have been both skilful and zealous in the service, the evidence was very contradictory. Some witnesses deposed that he had frequently denounced it as incompetent and dangerous, and others declared that it was a favourite with him, and that he took great pride and pleasure in guiding it. The charge of want of skill and judgment in placing the weaker engine before the more powerful one was rebutted. This was proved by men of experience to be the universal practice, and the suggestion that the strongest engine must overrun the weakest was shown to be false and unfounded, as the swiftness did not depend upon power of traction; and further, that if the stronger machine, by drawing with greater force, took the weight of the train, the weaker, by being thus relieved, would go the faster, and thus keep out of the way of the other, and could not be overtaken by it. The last charge, that of the train being urged to an inordinate degree of velocity, was, like the others, a subject of strongly conflicting opinions. Many witnesses, as well from among the persons who were passengers as from others who observed it from the roadside when passing Sevres and Meudon, im-

mediately before the accident, testified that the train was then moving with a degree of rapidity that excited in their minds the most serious alarms. Opposing witnesses, however, affirmed that the train was not going at any greater rate than it usually ran when going direct, that is to say, without having to stop at the intermediate stations, as was the case in the present instance; and others deposed that a much greater velocity is constantly kept on many railroads without increase of danger. Upon the whole of the evidence it should seem that this deplorable disaster was occasioned by the breaking of the axle-tree of the hind wheels of the Matthew Murray, but the cause of this breakage could not be accounted for, and most certainly did not arise from her being overrun by the Eclair. The Court deferred giving its judgment till Saturday the 10th of December.—*Abridged from the Times.*

[The decision of the Court has been in favour of the defendants. The proceedings have not thrown any new light on the subject; and, strange as it may seem, the most correct and intelligible explanation of the causes of the accident which has yet appeared, is one to be found in the pages of an English Journal. The reader will perceive at once, that we refer to the excellent letter of "A Practical Engineer," published in the *Mechanics' Magazine*, page 341 of our present volume.—Ed. M. M.]

BAKER'S PATENT FOR IMPROVEMENTS IN THE MANUFACTURE OF BOOTS AND SHOES.

Sir,—In No. 23 of the *Mechanics' Magazine*, 31st January, 1824, (vol. I. page 367,) appears the following communication from a correspondent:—

"A friend of mine has obtained a patent for the insertion of a thin lamina of whalebone under the inner sole, which completely excludes the wet, even though the sole may be nearly worn through, the beneficial effects of which I have experienced by two years' trial." "S. D."

"Skinner-street."

The above appears to me to contain as clear an exposition as words can convey, of the principle of a recent patent for improvements in the manufacture of boots and shoes, an abstract of which is given in No. 995, 3rd Sept., 1842, of your Magazine. In fact, except in the materials used there is obviously not the slightest difference between the two.

The public have just cause for complaint, of the shadowy grounds on which patents are often nowadays obtained, by which their free use of well known and familiar materials in particular ways is prohibited. The patent referred to is a case in point: for what is better known or more commonly used than hair soles for putting within shoes, &c.? and except perhaps in the application of a coat of India rubber on the under surface, there does not appear to be anything new in the preparation of the material. The *principle*, or real merit of the improvement, is due to the earlier patentee of 1824; and consists in placing a layer of some material which resists the transmission of moisture between the inner and outer soles of shoes, &c. The first patentee used a layer of whalebone; and Mr. Baker, out of the large assortment of materials suitable for resisting moisture, has selected a layer of felted hair similar to what is used for false soles. This is the difference: but if the simple substitution of felted hair for whalebone form a just ground or claim for a patent right, why may we not, on the same principle, have patents for India rubber itself, cork, mackintosh, and other waterproof cloths, and similar articles, alone or in combination, to be used in this way, until the whole range of materials suitable for resisting moisture might come to be monopolized by patent rights?

I am, Sir, yours, &c.,

N. N. L.

December, 1842.

RENEWAL OF PATENT.

*Judicial Committee of the Privy Council, Dec. 8.*

(*Present—Lord* Campbell, *Mr. Justice* Erskine, *the Judge of the Prerogative Court, the Judge of the Admiralty Court.*)

SINISTER'S PATENT.

Mr. M. D. Hill and Mr. Webster appeared in support of the petition, which was opposed by the Solicitor-General and Mr. Cowling on the part of the staymakers.

This was an application under Lord Brougham's act for the renewal of a patent granted on the 18th of Dec., 1829, to Mr. James Sinister, of Birmingham, staymaker, for "an invention of improvements in weaving, preparing or manufacturing a cloth or fabric, and the application thereof to the making of stays and other articles of dress, which improvements are also applicable to other purposes." The petition stated, that before this invention the cloth used for stays (sateen) was woven according to the usual and well-known methods of weaving, and stays were made by placing two surfaces of such cloth together, and sewing or stitching by the hand in such manner as to leave the requisite spaces for the introduction of the

whalebone, steel, wood, cotton, or other article or material with which stays were filled; and that in stays so made the work was not performed with so much regularity, the stays in the process of making became soiled, and they did not fit so easily or pleasantly to the wearer. The petitioner, after bestowing much labour and expense in devising means to obviate these defects, had succeeded in discovering a method of weaving whereby the cloth or fabric might be formed into stays, consisting of two surfaces united together in a proper manner, the requisite open spaces to be filled with whalebone, so being left or made at the time the cloth was woven, and the method so discovered was applicable to other articles of dress, such as braces, purses, bags, or reticules, &c.

The extension of the term of the patent was moved for on the ground of the invention being of public utility, and on account of the expense the applicant had been put to in perfecting it, and in law proceedings.

Several witnesses were heard in support of the application, which was opposed by

The Solicitor General, on the ground that the described fabric was not a new invention, and because the applicant had failed to prove that the invention (if it were one) was of public utility, or that he had not derived that emolument from it to which he was fairly entitled.

After a short deliberation,

Lord Campbell said, that in this case their Lordships were of opinion that no sufficient case had been made out to entitle the applicant to a renewal of his patent.

## PATENTS GRANTED, IN IRELAND, FROM AUGUST 6, TO SEPTEMBER 13, 1842.

James Warren, of Montagu-place, Mile-end, Middlesex, gentleman, for an improved machine for making screws. Sealed September 3.

Thomas Cuthbert Cockson and George Ball, of the city of Dublin, merchants, for certain improved machines which facilitate the drying of malt, corn, and seeds; also the bolting, dressing, and separating of flour, meal, and all other substances requiring to be sifted. September 5.

William Handcock, the younger, of Amwell-street, in the county of Middlesex, gentleman, for certain improvements in combs and brushes. September 5.

Henry Clarke, of Drogheda, in the county of Louth, linen merchant, for improvements in machinery for lapping and folding all descriptions of fabrics, whether woven by hand or power. September 13.

William Newton, 66, Chancery-lane, in the county of Middlesex, civil engineer, for certain improved machinery for excavating and dredging earthy and stony matters, in the construction of railroads, canals, cleaning of rivers, harbours, and redeeming of marshy and alluvial soils; also for boring rocks, indurated clay, and other earthy matters, for the purpose of blasting and removing the same; the whole to be worked by steam or other power. September 13. (Communicated by a foreigner.)

William Henry Kempton, of South-street, Pentonville, in the county of Middlesex, gentleman, for improvements in the manufacture of candles. October 6.

Alexander Johnston, of Hill-house, in the county of Edinburgh, Esq., for certain improvements on carriages, which may also be applied to ships, boats, and various other purposes where locomotion is required. October 6.

Charles Augustus Preller, of 16, East-cheap, in the City of London, merchant, for improvements in machinery for preparing, combing, and drawing wool and goats' hair. October 6.

William Geeves, of Old Cavendish-street, in the county of Middlesex, gentleman, for improvements in machinery for cutting cork. October 6.

William Baker, of Grosvenor-street, Grosvenor-square, in the county of Middlesex, surgeon, for certain improvements in the manufacture of boots and shoes. October 8.

Thomas Banks, of Manchester, in the county of Lancaster, engineer, for certain improvements in the construction of wheels, and tires of wheels, to be employed upon railways. October 11.

John Anthony Tielens, of Fenchurch-street, in the City of London, merchant, for improvements in machinery or apparatus for knitting. October 14. (Communicated by a foreigner.)



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## HINDLE'S METHOD OF REVERSING LOCOMOTIVE ENGINES.

Fig. 1.

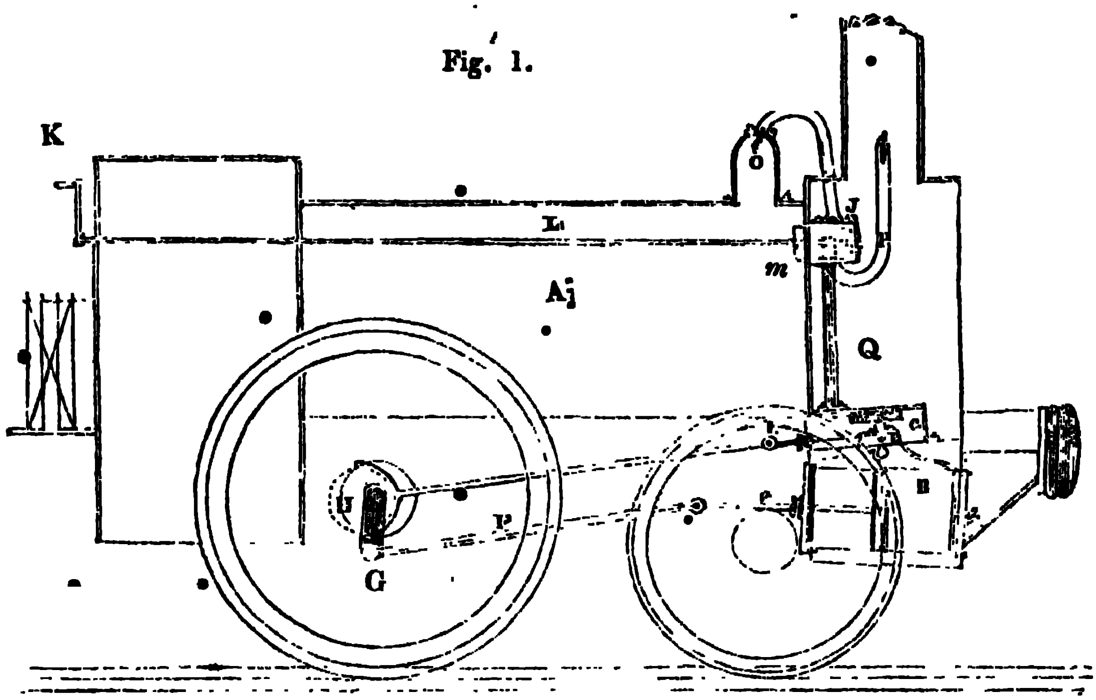



Fig. 2.

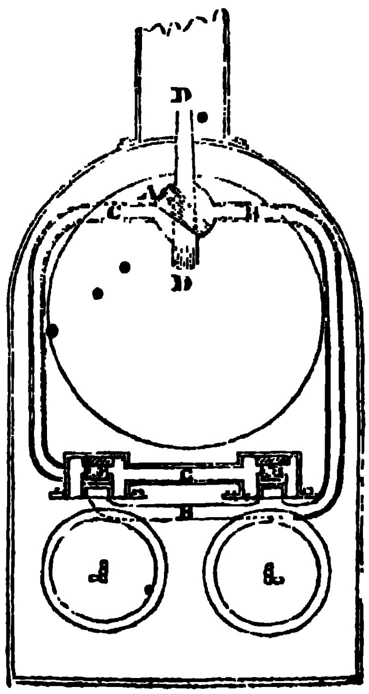



Fig. 3.

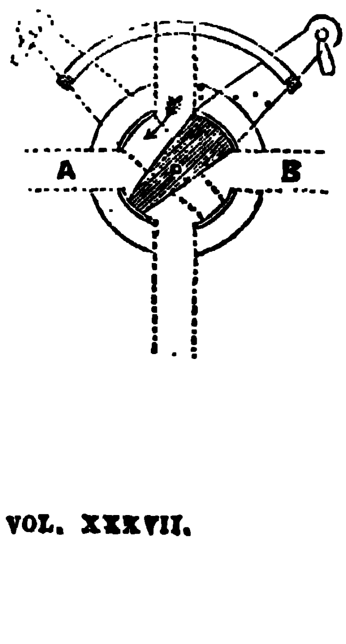
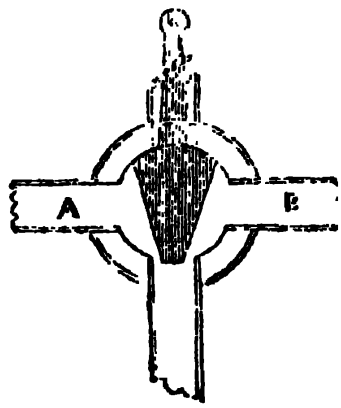



Fig. 4.



## IMPROVED METHOD OF REVERSING LOCOMOTIVE ENGINES.

Sir,—When reflecting on the state of perfection which mechanics have arrived at, I often wonder that a more simple plan has never been devised for reversing locomotive engines than the present imperfect one, of using four eccentrics with forked rods, (two of which are always working to no effect). In one of your recent volumes, there was a method by Mr. Charles Pearce, for working the valves of locomotive engines with two fixed eccentrics, with a double set of forks, which is, so far, a great improvement on the common plan. I now beg to lay before your readers a method of reversing the action of locomotive engines with two eccentrics, the rods of which are *without forks or coupling-rods of any kind,* and are connected immediately from the crank-shaft to the valve-rod by a mere joint, (see fig. 1, Description of Engravings). In reversing an engine on my plan, the engine-driver has only the handle of the steam-cock to attend to, the same handle serving the double purpose of reversing the action of the engine, and letting on or shutting off the steam from the cylinders, (see figs. 3 and 4). I effect this by substituting a four-way cock, (placed in the smoke-box of the engine,) for the ordinary steam-cock. The four-way cock is employed in the following manner, that is to say, one of the passages serves for the blast-pipe, one for admitting steam from the boiler, one for giving the engine a forward motion, and the fourth for giving the engine the reverse motion, (see fig. 2). It will be seen that the steam from the boiler is admitted both above and below the valve-cup (or slide); but, to prevent the slide from rising when the pressure of the steam is on its under surface, I have introduced a small roller, running in two supports on the top of the slide, the roller working against a smooth projecting piece of iron or rail, cast to the top of the valve-box, (see fig. 6.)

### *Description of the Engravings.*

Fig. 1 represents an outline of a locomotive engine, with my method of reversing attached to it. A, the boiler; B, one of the cylinders; C, the valve-box; D, the slide; *e*, the piston-rod; F, the connecting-rod; G, the crank; H, the eccentric, with its rod attached to the valve by the joint I; J, the four-way (or steam) cock; K, the handle of the same, with its rod L, passing along the interior of the boiler, and firmly fixed in the centre of the plug, at *m*; N, the steam-pipe from the receiver, O, to the four-way cock; P, the exhausting or blast-pipe; Q, the pipe to admit the steam to the top of the slides, to give the engine a forward motion. The pipe for admitting the steam under the slides is not shown in this figure.

Fig. 2 shows the interior of the smoke-box, and the arrangement of the steam-pipes. A, the four-way cock, with the plug in the position for the steam to pass down the pipe B B, under the slides, and move the engine backwards, whilst the waste steam will pass through the valve-boxes, along the pipes C C, to the blast-pipe D D, into the chimney. Now, if we suppose the four-way cock-plug to be moved by the engine-driver a quarter of a revolution, the now steam-pipe will become the exhaust-pipe, and the exhaust-pipe the steam-pipe; and, consequently, the motion of the engine will be instantly reversed, with the least possible amount of trouble.

Figs. 3 and 4 represent enlarged sections of the four-way cock, as fixed to the engine, with the regulating lever attached to it, and shown in the following positions: in fig. 4, the lever is in the perpendicular position, with the steam shut off from the cylinders; but when it is in the position of fig. 3, the steam is directed down the pipe A, over the slides, and propels the engine in a forward direction; and when it assumes the position as shown by the dotted lines, the steam is directed down the pipe B, under the slides, and propels the engine backwards. Thus moving the handle of the four-way cock out of the vertical position, either to the right or left, we have a backward or forward motion, (as the case may require,) thereby obtaining the most complete control over the machine.

Figs. 5 and 6 show the method by which the valve-cup is kept in immediate contact with its seat, when the steam pressure is on its under surface. A, the cup; B, the roller, turning in two small brass steps, C C, the steps sliding freely upwards and downwards in the supports,

Fig. 5.

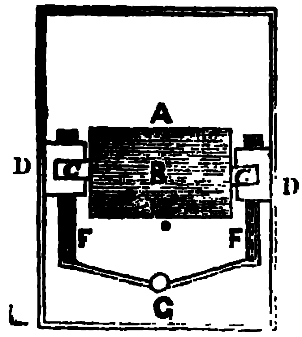
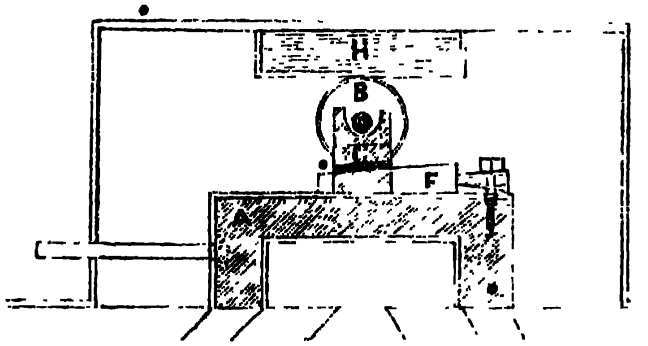



Fig. 6.




D D; F F are two slightly inclined iron wedges, which slide under the two steps that support the roller; G, a strong steel spring, fixed to the valve-cup by a pin through its centre, and pressing with its two ends against the wedges F F; so that, in the event of the valve becoming slack by use, the spring G will force the wedges under the brasses that support the roller, and bring it into close contact with the projecting rail H, fig. 6, and thus prevent the escape of steam.

The four-way cock, when applied to the cylinder of a steam-engine instead of the slide-valve, possesses the advantage of reversing the motion of the engine by applying the steam to the eduction-pipe, and *vice versa*. Though the sliding-valve is in every other respect greatly superior to the four-way cock, yet it does not of itself possess this property.

I remain, Sir, yours, &c.,

ROBERT HINDLE.

Preston, December 5, 1842.

P.S.—I find I have omitted to mention, that the plug of the four-way cock is so constructed, that when the engine is going down an inclined plane, and the steam shut off, the exhaust-pipe may have a free communication with the atmosphere. Also, by a slight alteration in the eccentric, the valves may be made to have the lead both ways.

## LIGHTNING CONDUCTORS.—WIRE-ROPE RIGGING.

Sir,—Had I the honour of a few years' personal acquaintance with Mr. Roberts, I have not the slightest doubt but that I should have implicitly believed any statement he might make, particularly if it bore the semblance of probability. Just so it is between myself and other parties with whom I have conversed on this subject. I cannot learn that Mr. Roberts ever applied wire-rope conductors to ships of the navy, or that his name is even known to the Lords Commissioners of the Admiralty. I am equally unsuccessful in my inquiries regarding ships in the merchant service, either in London or the outports, though having no particular reason for pursuing such an enquiry, it is quite possible that the mere accidental and limited information one person falls in with, may be far short of, and totally disagree with, the result of a more extended research.

There is no person in existence less inclined than myself to withhold from Cæsar his due, or to heap honours on one individual at the expense of another, and I regret that Mr. Roberts should have thought so. It appears to me that it is only necessary for Mr. Roberts to inform the public of the ships he has fitted with wire-rope conductors, or of its serviceable application by him in any other way, and he will at once place himself in the honourable position of a useful projector, and obtain all the merit due for such services, and whatever may have been said by others will become as "snow before the sun."

In making allusion to lightning conductors, when describing the Great Britain steam ship, I had no idea of the extent to which it had been carried, or of the interest it has occasioned in the public mind. A pamphlet, put forth by Mr. Smith, has lately been left at my office, by which I find that thirty-six ships of war, mounting in the aggregate 1411 guns, besides smaller craft, have been

fitted with iron-wire standing rigging and lightning conductors in her Majesty's navy by Mr. Smith, and that fourteen other additional naval ships have been fitted with wire-rope lightning conductors, besides twelve steam ships and vessels for various companies in the English merchant service during the last seven years, as also some for the Russian and other governments.

I am also informed that orders are now given for fitting thirty sail of the line with lightning conductors on the most efficacious and certain principle; therefore the subject appears to be considered of vast importance and deserving the most powerful investigation: I will therefore hazard a few additional remarks, more with a view to elicit useful and practical facts from others than from any idea that such can possibly result from myself.

The devastating effects of storms and tempests, supposed by many to be of electrical origin, which have within the last few weeks sent so many valuable seamen to their last account, besides the destruction of a vast amount of property, make the inquiry into the most certain means of preventing the injurious effects of lightning at the present moment doubly interesting, particularly as the stern face of winter is so near us.

I observe a lecture has lately been delivered by Lieut. Sabeen, R. N., at Plymouth, on the subject, embracing all the prominent considerations of lightning-conductors, drawing a comparison between the plan projected by Mr. Snow Harris and that practised by Mr. Smith, and arriving at a conclusion decidedly in favour of the latter.

In order that your readers may be able to judge for themselves I will, as briefly as possible, point out the object to be attained, and the means proposed and adopted by Mr. Harris and Mr. Smith for its accomplishment. The subject of aërial or atmospheric electricity has been so fully speculated and theorized on, that I presume it is generally supposed to consist of three different conditions; 1st, that the electric fluid surrounds and pervades every substance in nature with which we are acquainted in a quiescent or latent state, without affording the least sign of its existence; 2nd, that any body or substance may contain and be surrounded by more than is naturally due to it; and 3rdly, that such substance may contain less than its natural quantity by a portion having been removed. The first state has been called "latent," the second "positive," and the third "negative." The positive and negative electrical states appear to be produced from any cause of disturbance sufficient to destroy the molecular attraction of matter when two or more elements are in operation, and any change, such as chemical action, is taking place. Electricity is evolved by liquids passing into a solid state, as also by the liquefaction of solids, and the production and condensation of vapours from liquids holding either acids or salts in solution. Hence the sea produces amazing quantities, which is probably the cause of a clear atmosphere being generally positively charged—of contrary currents of wind, accompanied by humidity—and of any other change that may take place in atmospherical matter. The earth, ocean, atmosphere and clouds, may therefore become charged by their natural operations on each other, one part or district positively, and the other negatively; and although it is said that the earth and sea are often in the positive condition, I am of opinion, from repeated observations of lightning, that the positive state generally exists in the clouds when the earth and atmosphere are in contrary states, though probably the electricity of the earth and sea is frequently in a passive state, whilst the most violent commotion of electrical discharges is going on between the clouds. But the matter under enquiry being when the sea and clouds are in opposite states, I will confine my observations to that consideration, only observing, that these are general suggestions, details being foreign to my purpose.

Suppose several square miles of clouds to be aggregated in a highly excited condition, and to be drifted by currents of wind towards a fleet of ships, and that the ocean in the immediate vicinity of the vessels is in the opposite electrical state, should the approach of the clouds be only a little more than is equal to the striking distance of the redundant electricity, it can easily be imagined that the tall masts of a vessel interposing between the clouds and water would form a medium of communication, although the distance might be such that the aërial resistance would prevent a discharge

without some such intervening or conducting power.

The direction of a concentrated mass* of electric fluid when seen in the air is, I believe, almost always in straight lines, viz., taking the shortest path to the point where its presence is required to restore equilibrium; nor is the apparent zig-zag lightning an exception, because, although angular paths are formed, the cause of such appearances would be the vicinity of detached masses of clouds having their attractive and repellent forces in different directions as seen by the eye. I will therefore proceed to enquire what is the best means of constructing the conductors for ships which shall possess the greatest facility for the transmission of the electric fluid from the top of the mast to the water, in the most direct manner, and which, at the same time, shall not produce any obstruction or inconvenience to the seamen?

Mr. Harris's proposition is to let vertical slips of copper, about 2 inches wide, into the surface of the mast, to be fastened by nails, making the surface of the mast flush and even. These slips of copper to extend from the top of the upper mast down through the deck and hold to the kelson, and where, if I understand Lieutenant Sabeen's description, it ceases; having, in fact, brought the lightning *into* the hold of the ship, it has to find its own way out by the bolt of the frame work in the best manner it can. Lieut. Sabeen raises an objection to letting in the slips of copper, inasmuch as its contact on the inside and edges leaves only the outside surface free for the conducting operation. I do not consider this a very forcible objection. It is not possible, from the very nature of the work, that a carpenter can let in, and fix a copper plate with such extreme and perfect contact, as not to leave sufficient space for the passage of a subtle fluid, which, in such a case, is not supposed to require any; and, indeed, if it were so, the objection is nearly as applicable to the wire rope, as to the slips of copper; for the minute spaces formed by the tangential contact of the wires, would be almost as impermeable to the passage of electricity, as the partial contact of the slips of copper in the grains of the wood; therefore, I consider the objection is quite gratuitous when applied to the masts; but would, nevertheless, be particularly applicable to the bolts by which the electricity has to find its way out of the hold to the water. Bolts used in framing the ship, I apprehend, are in all cases *driven in*, and completely fill the holes: there can be no yielding, either in wood or metal, in this case, and therefore the contact may be presumed to be perfect; but I do not consider that even this has been the primary cause of the disruption of the frame-timbers spoken of as having occurred to Mr. Harris's plan, but should rather be inclined to ascribe it to the absence of a perfect continuity of the slips of copper forming the conducing material, and the bolts intended to transmit it to the water. A much stronger objection may be stated to take place at the junction of the pieces of metal for want of perfect contact. Dr. Priestley found that a considerable weight was necessary to bring the links of a chain in such a state of contact as to prevent decomposition of part of the metal, in conducting electrical discharges by it; besides which, other experiments have proved that bringing metals to touch does not produce perfect electrical contact, but that considerable pressure is necessary. The entire height of the masts of a first-rate war-ship being from 150 to 200 feet, and the slips of copper being, say 4 feet, there would be from forty to fifty partial interruptions by the "butt joints" in addition to those at the caps, cross-trees, and decks in a lateral direction. It has also been discovered in very carefully conducted experiments, that metals are shortened by powerful discharges of electricity being sent through them, which would sensibly increase the evil, though if long lapped joints were introduced, it would be obviated. The uppe masts and guns of a ship having to be so frequently removed and replaced in uncertain weather by the seamen, when neither time nor talent is sufficient to ensure perfect contact, and under circumstances too, when, of all others it is most required, appears to me a strong argument against the use of rigid plates or strips of metal, for such an important purpose; but the greatest absurdity of all is, that of bringing the most instantaneously destructive element *into* the hold of the ship, and making no other than a "bewildering" process for its escape. Not

much less reprehensible would have been the conduct of the builder of St. Martin's church (the accident to which, arising from carelessness, will be remembered by all your readers,) had he brought the conductor from the top of the tower into the sacramental plate chest, and from thence to the earth let it follow its own capricious fancy.

The question of suitability having been considered, I will now speak of the cost. From the close observation of unquestionable authority, it appears that the various operations of letting in and fixing the copper slips, making all the necessary bends and junctions at the heads of the masts, decks, and hold, occupy a period of three weeks; and that the cost, in the few instances in which it has been applied, has been from 400*l.* to 500*l.* Three weeks so occupied, under the ordinarily judicious regulations of our naval service, would probably be of as little consequence as the above sum taken from our Treasury, provided the work were worth it; but such does not appear to be the case. Both, however, must be weighty objections to the proprietors of small trading craft; to which we must add, the injury to masts and spars by letting in and puncturing, by holding the water and thereby occasioning decay; as also the impossibility almost of transferring the materials from one ship to another; or, in the case of masts and spars being carried away or left unprotected, the labour of fixing which probably amounts to four-fifths of the entire cost.

It only now remains for me to speak of the plan so successfully practised by Mr. Smith, and which, from its extreme simplicity, the facility with which it is applied, the certainty of its usefulness, and small cost, renders but few words necessary. I know of no instance amongst the numerous beneficial measures adopted by the present enlightened Government of this country, in which a more judicious and sound discretion has been evinced than in the adoption of Smith's Lightning Conductor. It contains all that is necessary and nothing further. A copper wire rope is tinned over and fastened on the cap of the topmast and is led down by the side of the masts to the cross trees, where it is fastened to a slip copper hook, and thence conveyed down the after shroud and shackled to a copper plate let into the ship's side, until it reaches the lower edge of the upper tier of copper sheathing, where it ceases.

By this simple use and arrangement of a copper wire rope every necessary condition is complied with, and the ease and facility with which a flexible rope may be made continuous by knots, splices, and other means must be obvious to every one under every circumstance to which a ship is exposed. The consequence of such simplicity is, that it can be applied in a very short time, two days, I am informed, being sufficient to protect a first class ship of war, and the expense of which does not exceed 60*l.* In the event of its being desired to transfer a set from one ship to another, the materials are in no way injured or rendered unfit; and in making alterations, the usual knowledge possessed by seamen will be equal to the task; and at all times, the materials forming these conductors, when removed, will be worth two-thirds the first cost.

These important considerations of cheapness and facility with which it can be applied, bring it within the reach of all owners of vessels, who will doubtless eventually appreciate the value and avail themselves of the benefit.

Mr. Smith's Pamphlet contains many most favourable certificates from naval officers, masters of merchant vessels, and others of nautical experience; and I have also seen certificates which have not been published, the whole of which form an additional link in the chain of evidence of its superiority over all other methods in use.

Not being fully acquainted with the "copper works" of a ship, I do not see why the wire rope used at the topmast should be of less diameter than the lower set; as far as the transit of lightning is concerned it would appear that a rope of uninterrupted and uniform diameter would be preferable; and if it were altogether increased from three-eighths to half inch, or five-eighths in diameter, it would be still better adapted for the conduction of large quantities of electricity.

In the hope that these remarks may be sufficiently interesting to appear in your columns.

I remain, Sir, yours respectfully,

J. R. Hill.

98, Chancery Lane, Dec. 12, 1842.

### PIRACY OF TRADE-MARKS.

*Rolls' Court, Chancery-lane, Wednesday, Dec.* 21.

*Baker* v. *Cole.*

*Mr. Dixon*, for the plaintiff, William Baker, moved *ex parte* for an injunction to restrain the defendant, Richard Cole, from using the trade-mark or name of "Impilia" upon the sole of any boots or shoes sold by him, or by his direction, and from selling any boots or shoes with that trade-mark or name thereon, or any boots or shoes made according to the plaintiff's patent. The plaintiff's affidavit stated that he had discovered a new and useful invention for an improvement in the manufacture of boots and shoes, for which, in January last, he had obtained a patent, and had, in July, enrolled his specification. The invention was specified to be "the applying a piece or sole of matted or felted horse or other strong curled hair between the inner and outer sole of the boot or shoe." The plaintiff had designated the articles thus made by the name of "Impilia," which name had become universally known as designating his boots, and never had been before so used; but he had caused it to be adopted as the trade-mark of the boots and shoes made according to his patent. He discovered on the 17th instant, that the defendant was selling boots and shoes which he represented to be "Impilia" boots, &c., made according to the plaintiff's patent, excepting that instead of horse-hair there was wool placed between the soles. The defendant had sold to a man of the name of Wise a pair of these boots, with the word "Impilia" upon the outer sole.

Injunction granted.

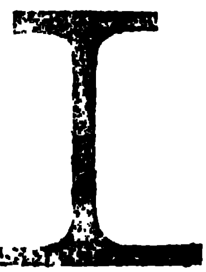
### MOSELEY'S MECHANICAL PRINCIPLES OF ENGINEERING AND ARCHITECTURE.—CONCLUDING NOTICE.

The theory of rupture by transverse strain is illustrated by a new class of problems, having reference to the forms of beams with wide flanges, connected by slender ribs, which will be found fraught with useful practical instruction. But here, again, the reader will not fail to be forcibly struck with the subordinate part which the mathematician plays, compared with the experimenter. For example:—

"Thus, then, it follows, that the strongest form of section in a cast-iron beam is that by which the material is collected into two *unequal* flanges, joined by a rib, the greater flange being on the extended side; and the proportion of this inequality of the flanges being just such as to make up for the inequality of the resistances of the material to rupture by extension and compression respectively. *Mr. Hodgkinson, to whom this suggestion* is due, has directed a series of experiments to the determination of that proportion of the flanges by which the strongest form of section is obtained. The details of these experiments are found in the following table:—

| No. of Experiment. | Ratio of the section of the flanges. | Area of whole section in square inches. | Strength per square inch of section. |
|---|---|---|---|
| 1 | 1 to 1· | 2·82 | 2368 |
| 2 | 1 to 2· | 2·87 | 2567 |
| 3 | 1 to 4· | 3·02 | 2737 |
| 4 | 1 to 4·5 | 3·37 | 3183 |
| 5 | 1 to 5·5 | 5·0 | 3346 |
| 6 | 1 to 6·1 | 6·4 | 4075 |

"In the first five experiments, each beam broke, by the tearing asunder of the lower flange; the distribution by which both were about to yield together—that is, the strongest distribution—was not, therefore, up to that period, reached. At length, however, in the last experiment, the beam yielded by the compression of the upper flange. In this experiment, therefore, the *upper* flange was the weakest; in the one before it, the *lower* flange was the weakest. For a form between the two, therefore, the flanges were of equal strength to resist extension and compression respectively, and this was the strongest form of section. In this strongest form, the lower flange had six times the material of the upper. It is represented in the accompanying figure.



"In the best form of cast-iron beam or girder used *before these experiments*, there was never attained a strength of more than

2885 lbs. per square inch of section. There was, therefore, by this form, a gain of 1190 lbs. per square inch of the section, or of $\frac{2}{5}$ths the strength of the beam."—Page 558.

It is only in the case of cast-iron beams that it is *customary*, by varying the form of the section, to effect a saving of material; but Mr. Moseley sees no reason, as neither do we, why the same principle of economy should not be equally applicable to beams of wood.

The following general enunciation, by the Professor, of the conditions requisite to the production of a "solid of the strongest form, with a given quantity of material," is one of the happiest, because clearest and most intelligible, in the whole work.

"The strongest form which can be given to a solid body, in the formation of which a given quantity of material is to be used, and to which the strain is to be applied under given circumstances, is that form which *renders it equally liable to rupture at every point;* so that when, by increasing the strain to its utmost limit, the solid is brought into the state bordering upon rupture at one point, it may be in the state bordering upon rupture at every other point. For, let it be supposed to be constructed of any other form, so that rupture may be about to take place at one point when it is not about to take place at another point, then may a portion of the material evidently be removed from the first point, without placing the solid there in the state bordering upon rupture, and added at the second point, so as to take it *out* of the state bordering upon rupture at that point; and thus the solid, being no longer in the state bordering upon rupture at any point, may be made to bear a strain greater than that which was before upon the point of breaking it, and will have been rendered stronger than it was before. The first form was not, therefore, the strongest form of which it could have been constructed with the given quantity of material; nor is any form the strongest, which does not satisfy the condition *of an equal liability to rupture at every point.*

"The solid constructed of the strongest form with a given quantity of a given material, so as to be of a given strength under a given strain, is evidently that which can be constructed of the same strength with the least material; *so that the strongest form is also the form of the greatest economy of material.*"—Page 533.

We must now bring our rather extended (yet very imperfect) examination of this generally most valuable work to a close; but before doing so, we must advert briefly to what we consider its chief defects.

In the first place, we must state our strong impression, that it is by far too learned for the classes (Engineers and Architects) for whose use it is specially designed. To be read and understood with ease, it requires that the reader should be master of all the arts and even refinements of mathematical analysis, and that is more, we fancy, than one in ten of the respectable classes (excellent practical men, notwithstanding) can pretend to be.

In the second place, the learning is not seldom of rather a superfluous character; showing, it may be, great proficiency and skill on the part of the author, but calculated to be of no practical service.

And, in the third place, the author, in his fondness for theorizing, forgets, occasionally, how essential it is to every sound theory, that it should be based on facts.

We may cite, as a striking example of all these three defects, the whole of the section on that very simple and useful agent in machinery, the *band*. Every mechanic knows that the best arrangement for communicating the motion of one shaft to another through the medium of a band and drums, is to apply the moving and working pressures on the same side of a vertical line passing through the axes of the two drums: every mechanic knows too, that a band is worked to most effect when the two portions of the band between the drums are made to cross one another. Neither can any mechanic of common intelligence be at any loss for the causes of both results—namely, the parallelism of the pressures in the one case, and the greater portion of each drum embraced in the other. Effects and causes so well known, and so obvious as these, might, with propriety, have been disposed of by a simple enunciation; but our very learned Professor must needs demonstrate them mathematically, and in doing so puts one forcibly in mind of Swift's definition of this sort of scholastic accomplishment—namely, that it is "the putting a number of queer looking things through a

number of very queer manœuvres in order to place them just as they were." The reader sees a multitude of strange signs and symbols paraded before him, and much disposing and transposing of the motley group, till the whole are arranged into a certain number of squares (called equations) by which he is given to understand, that that which he knew to be true before, is rigidly demonstrated after the most approved Cambridge fashion. He admits it may be so, but wonders that Cambridge people should put themselves to so much trouble to no purpose. He can see too (being, as we suppose him to be, a practical man,) that amidst all this display of mathematical skill, there is at bottom but an imperfect acquaintance with the thing itself, which is the subject of it. Take, for example, Mr. Moseley's demonstration of a certain principle said to have been first promulgated by Poncelet, and amply confirmed by the experiments of Morin, that "the sum of the tensions upon the two points of a band is the same whatever be the pressure under which the band is driven, or the resistance overcome, the tension of the driving point of the band being always increased by just so much as that of the driven point is diminished." Neither Poncelet nor Morin has given any demonstration of this principle; Mr. Moseley does, and in these words:—

"In the *very commencement* of the motion of that drum to which the *driving* pressure is applied, no motion is communicated by it to the other drum. Before any such motion can be communicated to the latter, a *difference* must be produced between the tensions of the two parts of the band sufficient to overcome the resistance, whatever it may be, which is opposed to the revolution of the *driven* drum. Now, an increase of the tension on the driving side of the band must be followed by an *elongation* of that side of the band (since the band is elastic), and by the revolution of the circumference of the *driving* drum through a space precisely equal to this elongation. Supposing, then, the other, or driven side of the band, to remain extended, as before, in a straight line between its two points of contact with the drums, this portion of the band must evidently have *contracted* by precisely the length through which the circumference of the *driving* drum has revolved, or the driving side of the band *elongated*. Thus, the elongation of the driving side of the band is precisely equal to the *contraction* of the driven side. Now, the band being supposed perfectly elastic, the increase or diminution of its tension is exactly proportional to the increase or diminution of its length. The increase of tension on the one side, produced by a given elongation, is therefore precisely equal to the diminution of tension produced by a *contraction* equal to that elongation on the other side."—Page 234.

The supposition on which this demonstration rests, that a certain *contraction* takes place on the driven side of the band, every practical man must at once pronounce to be a great mistake. *Contraction* there is none, and can be none. If there were, there must be some *contracting* force; but where is it? The only active force in the case is the driving pressure, but that could not both *elongate* and *contract* the same band (even on the opposite sides of a drum,) at one and the same time; to suppose so, would be to suppose a mechanical absurdity. The one side of the band is elongated (tightened) more than the other, and it may be that the degree in which the one side is elongated is exactly proportional to the degree in which the other remains of its original length; but to say that a band is *contracted*, because it is not more or less *elongated*, is an obvious misuse of language. That the degree in which one side is elongated is in reality exactly proportional to the degree in which the other remains of its original length, though probable, is by no means certain; for it is a fact familiar to all persons who have any thing to do with bands and drums, and one which renders Mr. Moseley's demonstration still more inadmissible, that it often happens that the tighter the driving side of a band is, the *slacker* is the band on the driven side.

We promised, when noticing the section of the work which treats of Friction, to give at length the excellent Tables by which it is illustrated; but we find that our present limits will only allow of our annexing that which exhibits the "friction of plane surfaces in motion one upon the other." It is, however, by far the most valuable of the whole.

## TABLE.

**Friction of Plane Surfaces in motion one upon the other.**

| Surfaces in Contact | Disposition of the Fibres | State of the Surfaces | Co efficient of Friction | Limiting Angle of Resistance |
|---|---|---|---|---|
| EXPERIMENTS OF M MORIN | | | | |
| Oak upon oak | parallel | without unguent | 0 48 | 25° 39′ |
| | ditto | rubbed with dry soap | 0·16 | 9 6 |
| | perpendicular | without unguent | 0 34 | 18 47 |
| | ditto | steeped in water | 0 25 | 14 3 |
| | wood endways on wood lengthways | without unguent | 0·19 | 10 40 |
| Elm upon oak | parallel | ditto | 0 43 | 23 17 |
| | perpendicular | ditto | 0 45 | 24 14 |
| | parallel | ditto | 0 25 | 14 3 |
| Ash, fir, beech, wild pear-tree, and service-tree, upon oak | ditto | ditto | 0·36 to 0 40 | 19 48 / 21 49 |
| Iron upon oak | ditto | ditto | 0 62 | 31 48 |
| | | with water | 0 26 | 14 35 |
| | | rubbed with dry soap | 0 21 | 11 52 |
| | | without unguent | 0 19 | 26 7 |
| Cast iron upon oak | ditto | with water | 0 22 | 12 25 |
| | | rubbed with dry soap | 0 19 | 10 16 |
| Copper upon oak | ditto | without unguent | 0 26 | 31 48 |
| Iron upon elm | ditto | ditto | 0 25 | 14 3 |
| Cast-iron upon elm | ditto | ditto | 0 20 | 11 19 |
| Black dressed leather upon oak | ditto | ditto | 0 27 | 15 7 |
| Tanned leather upon oak | flat, or lengthways and edgeways | ditto | 0 30 to 0 35 | 16 42 / 19 18 |
| | | with water | 0 29 | 16 11 |
| Tanned leather upon cast-iron and brass | ditto | without unguent | 0 56 | 29 15 |
| | | steeped in water | 0 36 | 19 48 |
| | | greased and steeped in water | 0·23 | 12 58 |
| | | with oil | 0·15 | 8 32 |
| Hemp, in threads or in cord, upon oak | parallel | without unguent | 0·52 | 27 29 |
| | perpendicular | with water | 0 33 | 18 16 |

| Surfaces in contact. | Disposition of the Fibres. | State of the Surfaces. | Co-efficient of Friction. | Limiting Angle of Resistance. |
|---|---|---|---|---|
| EXPERIMENTS OF M. MORIN.—*continued.* | | | | |
| Oak and elm upon cast-iron | parallel | without* unguent | 0·38 | 20 49 |
| Wild pear-tree, ditto ........ | ditto | ditto | 0·44 | 23 45 |
| Iron upon iron ............ | ditto | ditto | 0·44 | 23 45* |
| Iron upon cast-iron and brass . | ditto | ditto | 0·18† | 10 13 |
| Cast-iron, ditto ............ | ditto | ditto | 0·15 | 8 32 |
| Brass upon brass .......... | ditto | ditto | 0·20 | 11 19 |
| Brass upon cast-iron ....... | ditto | ditto | 0·22 | 12 25 |
| Brass upon iron .......... | ditto | ditto | 0·16‡ | 9 6 |
| Oak, elm, yoke elm, wild pear, cast-iron, wrought-iron, steel, and moving one upon another, or on themselves | ditto | greased in the usual way with tallow hog's lard, oil, soft gom | 0·07 to 0·08§ | 4 1 / 4 35 |
| | ditto | slightly greasy to the touch | 0·15 | 8 32 |
| Calcareous oolite stone upon calcareous oolite | ditto | without unguent | 0·64 | 32 37 |
| Calcareous stone, called muschelkalk, upon calcareous oolite | ditto | ditto | 0·67 | 33 50 |
| Common brick upon calcareous oolite | ditto | ditto | 0.65 | 33 2 |
| Oak upon calcareous oolite | wood endways | ditto | 0·38 | 20 49 |
| Wrought-iron, ditto ........ | parallel | ditto | 0·69 | 34 37 |
| Calcareous stone, called muschelkalk, upon muschelkalk | ditto | ditto | 0·38 | 20 49 |
| Calcareous oolite stone upon muschelkalk | ditto | ditto | 0·65 | 33 2 |
| Common brick, ditto ........ | ditto | ditto | 0·60 | 30 58 |
| Oak upon muschelkalk | wood endways | ditto | 0·38 | 20 49 |
| Iron upon muschelkalk ...... | parallel | ditto | 0·24 | |
| | parallel | saturated with water | 0·30 | 16 42 |

## ANTIPHLOGISTIC FLUIDS FOR THE EXTINGUISHING OF FIRE—MURPHY *v.* THE LORDS OF THE ADMIRALTY.

Sir,—Some correspondence has lately passed between the Board of Admiralty and a Mr. D. J. Murphy, respecting a very wonderful discovery which this gentleman supposes he has made, of a means of increasing the extinguishing power of water for the suppression of fire, by saturating it with "common salt

* The surfaces wear when there is no grease.
† The surfaces still retaining a little unctuousness.
‡ Ibid.
§ When the grease is constantly renewed and uniformly distributed, this proportion can be reduced to 0·05.

and potash;" the former alone, says Mr. Murphy, "will be found quite effectual in all ordinary cases." Combined with this supposed discovery, were several crude plans for carrying it into effect, remarkable only for the complete ignorance which Mr. Murphy displays of every branch of the subject on which he has undertaken to enlighten "My Lords."

Among other things, Mr. Murphy recommends, for the protection of the dock yards, *elevated tanks* of impregnated water, "the weight and force of the body of which is to raise it *to a higher elevation!*"

The Lords Commissioners of the Admiralty having taken into consideration Mr. Murphy's plan, and his request for an experiment, sent him an answer, stating that, "as it is *well known* that water mixed with *salt*, *potash*, *alum*, and various other substances, will extinguish fire, their lordships did not think it necessary to make any experiment, nor to give Mr. Murphy any further trouble on the subject." As this reply gave a knock-down blow to the discovery which Mr. Murphy fancied he had made, he thereupon waxed exceedingly wroth, and threatened to "publish the whole plan in a pamphlet." Mr. Murphy has kept his word, and his pamphlet is now before me, in which he *appeals* from the decision of the Lords of the Admiralty "to the *British public*."*

As one of those appealed to, therefore, I beg to answer a question of Mr. Murphy's, to which he could hardly expect the Lords of the Admiralty to condescend: viz., "whether it *was well known before* that water impregnated with *salt*, *potash*, &c., was capable of extinguishing fires?" For, this fact, says Mr. Murphy, "I, in emphatic, but respectful language, beg leave to question; and I doubt if my Lords can produce any authority in *books*, or other evidence, either documentary or oral, stating, or even *remotely hinting*, at such a discovery."

If "My Lords" do not produce the challenged authority, it certainly cannot be from its not being forthcoming.

Without troubling myself to present a great number of authorities, I shall just refer to a few which happen to be at hand, and which are abundantly sufficient to dispose of Mr. Murphy's claim to be considered an original discoverer in this matter.

I would first refer to the experiments of M. Van Aken, in 1794, which were celebrated throughout Europe, and were noticed in your Magazine, vol. 3, p 184, and also in the *Artisan*, page 383.

In 1816, the humane and ingenious Captain Manby made several experiments with his "Antiphlogistic Fluid," a saturated solution of pearlash: a most conclusive experiment being made before the government authorities, at Woolwich, in 1817. Captain Manby made no claim to the discovery of thus increasing the extinguishing properties of water; on the contrary, he quoted several authorities, to show that the subject was *long known* and well understood;—merely claiming for himself the merit of the very novel and ingenious mode which he had devised for its *projection*. Captain Manby's experiments and apparatus were described in the *Gentleman's Magazine*, in 1822; this paper was reprinted in the 3rd volume of the *Mechanic's Magazine;* and in 1838 Captain Manby published a collection of this, and all his other humane contrivances, in a small volume dedicated to her Majesty.

More recently, one of your correspondents suggested that a cart laden with *salt* should be kept at each station, to accompany the engine when called out; the salt to be mixed with the water supplied to the fire-engines, just in the same way as is now re-suggested by Mr. Murphy. (See Vol. x. p. 330 and 363.)

The following pertinent extract is from *The Engineer's and Mechanic's Cyclopædia*, published by Kelly in 1838:—

"The most suitable and convenient material for extinguishing fire is water; but when that cannot be speedily obtained in sufficient abundance, it has been proposed to increase its extinguishing properties, by the addition of various substances. M. Van Aken, a Swede, employed an antiphlogistic composition of water, holding in solution sulphate of iron, sulphate of alumine, red oxide of iron, and clay, with which he performed several successful experiments. Some persons have recommended the employment of simple solutions of either of the following substances,—alum, common salt, pearl-ash, and several other salts and alkalies."

* "A Plan for the More Speedy and Effectual Extinction of Sudden and Destructive Fires," &c. By D. J. Murphy. pp. 16. George Mann, Cornhill

Now it must be conceded that Mr. Murphy's *discovery* is more than *remotely hinted* at in these *books*; and he must really be content to forego his claim to a niche in the temple of fame, between *Columbus* and *Watt*.

Upon a careful consideration of the foregoing evidence, I feel myself bound to confirm the decision of the Lords Commissioners of the Admiralty—with costs.

I am, Sir,
Yours respectfully,
WM. BADDELEY.

29, Alfred-street, Islington,
December 15, 1842.

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SMOKE BURNING.

At a meeting of the Liverpool Polytechnic Society, held on Tuesday last, Mr. J. Smith read a paper on "*Smoke Burning*," in which he gave a general review of the different inventions for attaining this desirable object. He classified them under three heads:—1. Those requiring water or steam, as introduced in the patents of Chappe and of Ivison. 2. Those requiring a red-hot surface of fuel over which to pass the smoke, as in the plans patented by Thomas Hall, Chanter, Drew, and others, which he considered most unscientific arrangements of the furnace. 3. The employing hot or cold air, as in the furnaces of Samuel Hall, C. W. Williams, and Joseph Williams. Mr. S. Hall's plan he considered complicated and liable to affect the draught. He then entered at considerable length into a review of the treatise *On the Combustion of Coal*, by Mr. C. W. Williams, and the merits of his patent argand furnace, and concluded by noticing the plan of Mr. Joseph Williams, commonly called Kurt'z patent, in which the air passes through a pipe near the fire-bars, and by which it became heated on its way to a box, where it is enclosed and allowed to escape through long narrow apertures, regulated by a valve. Mr. Smith stated that this plan had been successfully used in the steam packet *Urgent*, and in other steamers on the river.

The President having invited observations on this interesting subject, an animated discussion followed. Mr. C. Williams commented on the alleged patent of Mr. Joseph Williams, and, referring to the diagram as exhibited, pointed out its direct reference to his own, the air being admitted to the gases through thin longitudinal apertures, the effect of which was the same as if it passed through a series of smaller ones, as shown in some of the gas-burners in ordinary use. Mr. Williams observed, as to any effect being produced from the air being heated, that was an error, for if the pipe through which it passed was placed in any other direction the effect would be the same. As to this plan of Mr. Joseph Williams being, as Mr. Smith observed, commonly called Kurtz's patent, he had the authority of the latter gentleman for denying it; and that, in fact, he had indignantly stated that such plan was not conformable to his patent, and, further, that Mr. Joseph Williams had no patent.

Mr. Williams concluded by stating that the plan adopted by Mr. Joseph Williams was, in fact, the same as that introduced by him in several steam-vessels and land engines, and was a direct infringement of his patent.

Mr. Dircks made a few remarks on the necessary distinction between smoke and gas, in a popular point of view, and as exhibited in the flame of a common candle, where the gas is observed in the interior of the flame, and the smoke arising from the summit.

A gentleman asked if Mr. Williams meant to say that, by placing the pipe which conveyed the air to the bridge, in Mr. Joseph Williams's plan, in a vertical or other direction, the effect would be the same? To this Mr. Williams assented, adding, that it was a matter of indifference where or how the air was introduced, provided it was admitted by thin or small apertures, so as to produce immediate diffusion with the gases; and, in fact, corresponding with the well-known principle of allowing the gas, in the argand or other burners, to pass through small or narrow apertures to the atmosphere.

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EXTRAORDINARY EXTENSION OF PATENT RIGHTS IN THE UNITED STATES.

An Act of Congress has just been promulgated, which has obviously been suggested by the system of registration of designs lately introduced into England, but takes a flight beyond it, which to our minds is extremely startling. Here, the periods of protection sought for by the authors of designs varied from one to three years; nobody thought less than one sufficient, (except the opponents of all protection) and a triennial monopoly was by all regarded as the utmost that could in any case be reasonably desired. Again, though there was a common agreement among the petitioners for protection,

that every new and original design was a fit subject of copyright, no one with us ever broached the notion that all were deserving *an equal length of copyright;* as, for example, that a person should have as long a monopoly of a muslin sprig, as of an elaborate design in gold, silver, or brass. With our transatlantic friends, matters are far otherwise. On no other principle, apparently, than that favourite one with them, of going ahead of all the world beside, they have resolved that the authors of new designs, of all sorts and sizes, shall enjoy a monopoly of them for a period of—*seven years!* Designs of the least possible merit, and designs of the greatest—designs which are but for the day and the hour, and designs calculated to last through all time—designs produced by the mere turn of a kaleidoscope, and designs the fruit of great ingenuity and much labour—are all treated with the like uniformity of regard. The American sculptor (hitherto, we believe, without any protection whatever) is to have no more favour shown to him than is accorded to the meanest of American pattern-prickers. Is it a frieze for the Capitol, or a border for a lady's apron, that asks the protection of the state? 'Tis all one with our enlightened republican brother: he extends the state's protection to both alike, for the same length of time, and for the same price! So that each pays the same number of dollars into the public treasury, he sees no reason why they should not, in all other respects, be on the same footing.

The principal clause of the act of which we speak is in these terms:—

"And be it enacted, That any citizen or citizens, or alien or aliens, having resided one year in the United States, and taken the oath of his or their intention to become a citizen or citizens, who by his, her, or their own industry, genius, efforts, and expense, may have invented and produced any new and original design for a manufacture, whether of metal or any other material or materials, or any new and original design for the printing of woollen, silk, cotton, or other fabrics, or any new and original design for a bust, statue, or bas-relief, or composition in alto or basso relievo, or any new and original impression or ornament, or to be placed on any article of manufacture, the same being formed in marble or other material, or any new and useful pattern, or print, or picture, to be either worked into or worked on, or printed, or painted, or cast, or otherwise fixed on any article of manufacture, or any new and original shape or configuration of any article of manufacture not known or used by others before his, her, or their invention or production thereof, and prior to the time of his, her, or their application for a patent therefor, and who shall desire to obtain an exclusive property or right therein to make, use, and sell and vend the same, or copies of the same, to others, by them to be made, used, and sold, may make application in writing to the Commissioner of Patents, expressing such desire, and the Commissioner, on due proceedings had, may grant a patent therefor, as in the case now of application for a patent: Provided, That the fee in such cases, which by the now existing laws would be required of the particular applicant, shall be one-half the sum; and that the duration of said patent shall be seven years, and that all the regulations and provisions which now apply to the obtaining or protection of patents, not inconsistent with the provisions of this act, shall apply to applications under this section."

The protection, it will be observed, is not to be obtained (as with us) by registration simply. A patent is to be granted, in every case, the same as for an invention of the highest order, and the same formalities are to be gone through in obtaining it; the only difference is, that the patent is to be for one-half the usual period, and granted for one-half the usual fees.

We have no doubt that this new state of the law will produce a vast increase in the number of American patents, and a proportional increase in the public revenue derived from this source; but we cannot imagine that it can ever work to good in any other way. Either we are all wrong in this part of the world, as to the danger to trade and commerce of a multiplicity of monopolies, especially in small matters, and in the course of legislation which we have pursued for the proper protection of inventive genius; or this last Act of Jonathan's is the greatest act of folly he ever committed.

We anticipate that the American manu-

facturers will themselves be the first to feel, and to cry out against the infallibly injurious operation of the new law. The real hardship which it must inflict on a multitude of persons must alone go far to bring about its repeal. A calico-printer of Manchester can secure the copyright of a pattern for twelve months—which, in most cases, is as long as he wants to secure it—for the small sum of *one shilling*. The Solons of Washington, with the view of encouraging the native genius of their country (!!!), say that every American printer must either take out a protection for seven times twelve months, and pay from sixty to a hundred times more than the English printer, or go without any protection at all. How long is it expected that such a state of things can endure?

## FLYING ACCOMPLISHED.

Sir,—The possibility of flying by means of machinery has been long regarded by many as very problematical, and not unfrequently the subject has been treated with ridicule as a mere chimera of a fertile imagination. It would seem, however, from a paragraph which has recently appeared in some of the leading journals of the day, that, since the discoveries of the Daguerreotype and other astonishing processes, the subject of flying has begun to receive a different treatment;—that the practicability of constructing machines for the safe and speedy transport of persons and parcels through the air, is admitted, and about to be acted upon by a number of individuals, forming themselves into a company to bring out and perfect a mechanical apparatus for the purpose. It is asserted that a plan of such machinery has been matured, and approved for its simplicity and apparent efficiency. This, therefore, seems an opportune occasion to submit to the notice of your many readers the following facts—and facts are better than theories, plausible hypotheses, and bold assertions. Several years ago, Mr. T. Quilliams, of this town (Ulverstone, Lancashire), constructed a model of a flying machine, which automatically performed all the necessary evolutions of a vehicle for expeditious conveyance. Its performance was witnessed, and the ingenuity of it admired at the time, by several of his intimate friends, who can attest its satisfactory realization of the inventor's plan. More than a general description of it I am not able to furnish. It was put in motion, I understood, by springs, supporting itself without the aid of gas to raise or sustain it, and progressed with considerable speed, across currents of air, in any direction, deviating little, if any, from its intended path. The practicability and completeness of the scheme were fully proved. By proportionally enlarging the dimensions, a machine might be made of sufficient capacity for conveying persons, &c., in any direction, at the will of the aëronauts.

Mr. Quilliams, I have no doubt, would communicate the particulars of his invention, upon a moderate remuneration of his ingenuity, to proper applicants or capitalists, to whom he would, in confidence, *prove* the adequacy and efficiency of his machine. But with this, the writer of this communication has nothing to do; his object being merely to state the fact of Mr. Q. having, by successful experiment, proved the practicability of flying by machinery, and of his having invented a machine for that purpose.

I am, Sir, yours truly, P. J.

Ulverstone, December, 1842.

## PATENTS GRANTED, IN IRELAND, FROM OCTOBER 14, TO OCTOBER 19, 1842.

Eugene de Varroc, of Bryanstone-street, Portman-square, in the county of Middlesex, gentleman, for apparatus to be applied to chimneys, to prevent them taking fire, and for rendering sweeping of chimneys unnecessary. October 14.

William Revell Vigers, of Russell-square, in the county of Middlesex, Esq., for a mode of keeping the air, in confined places, in a pure or respirable state, to enable persons to remain or work under water, and in other places, without a constant supply of fresh atmospheric air. October 14.

Thomas Marsden, of Salford, in the county of Lancaster, machine-maker, and Solomon Robinson, of the same place, flax-dresser, for improvements in machinery for dressing or hackling flax and hemp. October 15.

Thomas Bell, of St. Austell, in the county of Cornwall, mine agent, for improvements in the manufacture of copper. October 15.

Julius Seybel, of 11, Golden-square, Westminster, in the county of Middlesex, manufacturing chemist, for certain improvements in the manufacture of sulphate of soda and chlorine. October 15.

Isham Baggs, of Wharton-street, in the county of Middlesex, chemist, for improvements in obtaining motive power by means of carbonic acid. October 15.

James Whitelaw, of Glasgow, in the county of Lanark, engineer, and James Stirratt, of Paisley, in the county of Renfrew, manufacturer, for improvements in rotary machines to be worked by water. October 19.

## NOTES AND NOTICES.

*Automaton.*—A mechanician of a little town in Bohemia, says the *Constitutionnel*, has constructed an automaton which imitates perfectly the human voice, particularly the soprano notes. It sings several difficult airs with the greatest accuracy. Shakes, runs, and chromatic scales, are all executed with surprising precision. This automaton, in singing, even pronounces certain words, so as to be easily understood.

*The Artesian Well at Grenelle.*—The water from this well now continues to run perfectly pure, and of the same temperature as at first, (from 80° to 90° Fahr.) M. Mulot has taken great pains to ascertain the exact quantity which flows from the aperture, which is now stated to be 475½ gallons in twenty-eight seconds.

*Submarine Telescope.*—A lady of Brooklyn has invented a method of illuminating objects under water, so that an observer at the surface, by means of a water-tight cylinder, having a glass inserted in its lower orifice, can make examination under water, to any accessible depth. By means of a reflector, the hull of a ship can also be examined from its deck. The fair inventor believes that the telescope will be found highly useful for this purpose, and that it may also be economically applied in the exploration of sunken wrecks, and in the pearl and sponge fisheries. It is now exhibiting, every evening, at Barnum's American Museum.—*New York Paper.* [Is this any thing more than the plan of our ingenious friend, Mr. Thomas Steele, revived?—Ed. M. M.]

*Prices of Gas.*—It appears by a recent report from the Manchester board of gas directors—"That in all large gas establishments—except those in Liverpool, where the price to all is 7s. per 1,000 feet—the charge varies according to the quantity used by different classes of consumers. With reference to their present report, the directors have applied for and obtained returns from 17 of the principal gas-works of the kingdom, and the average highest price charged by these 17 works is 8s 0¼d. per 1,000 feet; the average lowest price 5s. 10¾d., making an average difference between the charge to the smallest and largest consumers of 2s. 1½d. This is about the difference which existed in the Manchester scale till the year 1836, when a reduction of price was made of 1s. per 1,000 feet to the class of consumers paying the highest price, and none to the class paying the lowest price; leaving the difference here, as it at present stands, at 1s. per 1,000 feet." The new rate for supplying gas in Manchester commences at Christmas, when the present prices of 6s. to large consumers, and 7s. to small consumers, will be reduced to 5s. and 6s. per 1,000 cubic feet, according to the quantity consumed.

*Sinking an Artesian Well in the Sea.*—A curious experiment is now going on at the head of the chain pier, Brighton, that of raising fresh water from below the ocean by means of an Artesian well. It is intended to bore to the extent of 70 feet, at which depth the chalk formation will, it is expected, be penetrated, and fresh water obtained, which will be applied to the formation of a *jet d'eau.* The attempt, if successful, will be a most interesting work of art and science, as well as a great acquisition to the pier.—*Sun.*

*Merchant Farmers.*—Adam Smith said, seventy years ago, that merchants, from their habitual and enterprising handling of large concerns, were the most spirited of all agricultural improvers, and conformably with this opinion, the most original and most successful of all living improvers is not a landlord, or a farmer, but a merchant and manufacturer. Mr. Smith, of Deanston, has invented and largely practised a combined system of *thorough draining* and *deep ploughing,* by which wet land, producing nothing but docks, sedges, and *carices,* on which a hungry ass would disdain to dine, is made to yield at once—three, four, or five quarters of wholesome corn, or to produce good grass to feed a dozen sheep, where weeds grew before that would rot a hundred. Mr. Smith, if not the man that deserves well of his country for having made two blades of grass grow where only one grew before, he is something better, for he has made many blades of good grass to take the place of many noisome weeds. His system carried out (for much of England is undrained, and nearly all imperfectly drained) would be to the United Kingdom what the Nile and the Ganges are to Egypt and Bengal. It would not, indeed, add to the extent of the land, but it would do far better; it would add to the amount of fertile and productive land, and thus yield us more food, which is exactly what we most want. As matters now are, the very land we stand upon is, agriculturally speaking, a reproach to us.—*Examiner.*

*Ancient English Divers.*—(From the St. James' Evening Post, 25th Sept. 1729.) "Some days ago, Captain Hannibal, in the sloop *Cornelius,* brought over as passengers from Rotterdam, the two famous English divers living at Weymouth, having been three years in the Dutch East India Company's service, and had been sent to fish upon the wrecks of some ships of theirs in India. They gave a specimen of their skill before the Governors and Directors at Middleburgh, in Zealand, by diving in six fathom water, and staying at the bottom three quarters of an hour, bringing up some gravel in their hands. The Directors entered into a contract with them, agreeing to give six pounds per cent. for the treasure they should recover, and so for ohter goods in proportion to their value. The first trial they made was upon the wreck of a Dutch East India ship, that had been lost off Cape Coast in six fathom sea, in which they succeeded so well that they brought up at several times 3,600*l.* in silver. They dived also upon another wreck in eight fathoms, and brought up some bars of silver and gold, and several brass great guns: when one went to the bottom his companion stayed on board to pull him up as occasion offered, for they would trust to no foreigner. Their diving-engine they contrived in England, which was of wood, six hundred weight of lead being affixed to the bottom to sink it, and less would not do; the glasses before their eyes were three inches thick, and their hands were at liberty, to grope and fasten hooks to chests, and such other things as they had a mind to get up."

*Hotel Telegraph.*—Among the interesting improvements exhibited at the Fair of the American Institute in New York, is a telegraph for conveying information from the chambers of hotels to the office or bar. Its construction and operation are extremely simple. Its action is always certain and accurate. By means of this invention, the occupant of any room in a hotel in which this system is used, can convey information of his wants to the person in the office, in as short a time as he could ring a common bell, and can keep the bar-keeper constantly informed whether he is in or out. The inventor is Samuel Frew, Esq., of Alleghany county, Pa.—*American Paper.*

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# Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1012.] SATURDAY, DECEMBER 31, 1842. [Price 3*d*.

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## DR. HENDERSON'S GEO-CHORIONS.

Fig. 1.

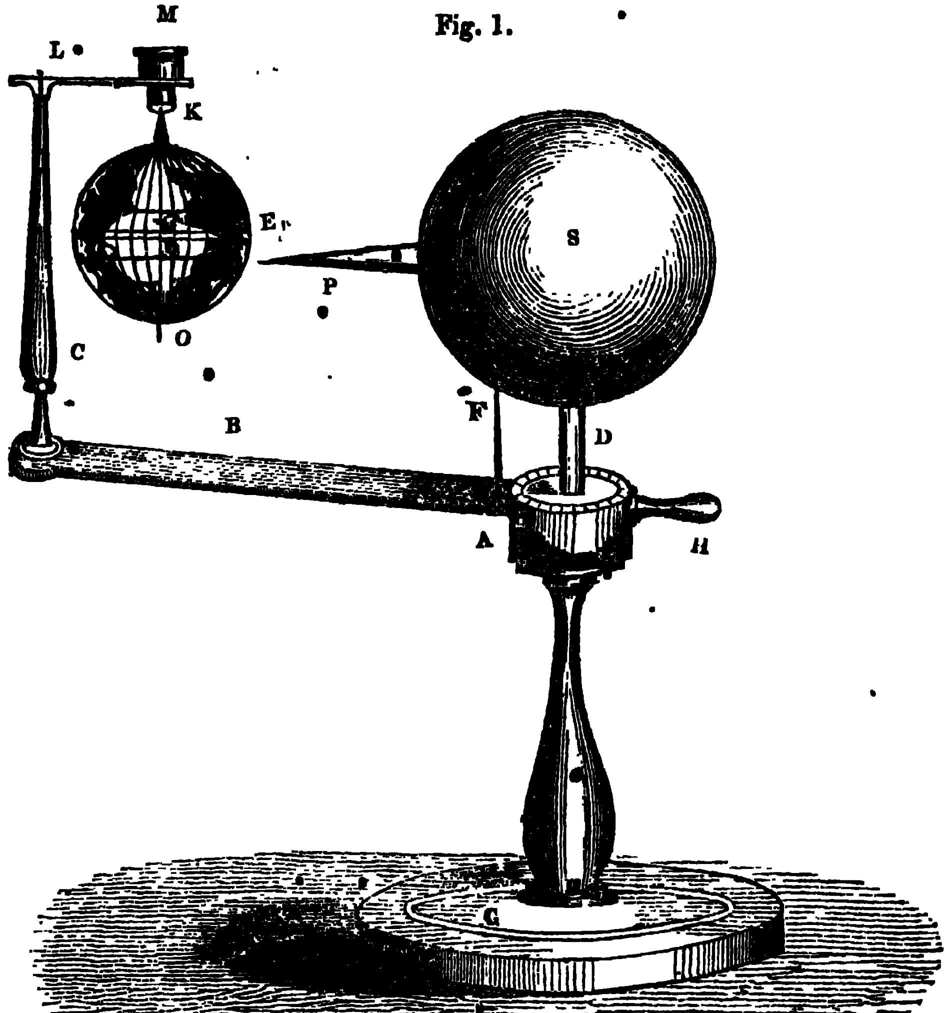
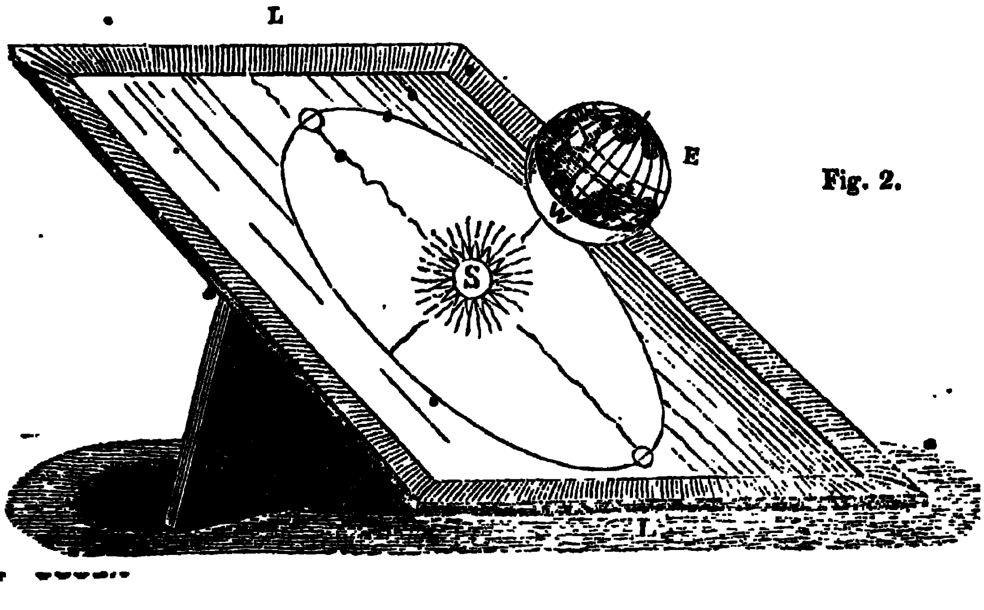



Fig. 2.



Sir,—The accompanying sketches are perspective representations of two pieces of my astronomical apparatus which I term Geo-chorions, or Season Illustrators, which were both invented by me several years ago. They illustrate, in a very pleasing and novel manner, the rotation of the earth on its axis. The motion of fig. 1 is accomplished through the agency of magnetism; and that of fig. 2, by a circular kind of friction motion, on an inclined surface of glass. The instruments are of very simple construction, and will be readily understood from the following description.

Fig. 1.—G represents a circular base, which supports a mahogany pillar, A, the top of which is bevelled off at such an angle, as to allow the ball of the earth to perform its circuit round the sun in an oblique path of 23½ degrees with the ecliptic: a bent wire is made fast in the top of the pillar, on which is placed loosely a large gilded ball, S, representing the sun. The bent wire just mentioned is at right angles to the oblique plane of the pillar; on this, as a centre, the horizontal bar, B, has its motion. On the extreme end of this bar a perpendicular pillar of brass, C, is made fast, which carries a horizontal slip or stage of brass, L, having a circular perforation large enough to admit a box, M, containing a strong bar magnet, the lower end of which protrudes at K, on which is suspended, by a steel axis, a small terrestrial globe of very light material, such as card, pith, or cork, with a map of the world delineated on it. The globe which I use is made of extremely thin india-rubber; in the centre of it is a circle of wood, to which is made fast the steel axis of the earth. The circle or disc of wood is firmly cemented to the *interior equator* of the rubber ball. After this is done, the substance is blown into a globular form, and then a map of the countries of the world laid down on it. Such a ball is scarcely of any weight, and consequently well adapted for this apparatus. When the ball E is finished, allow its steel north polar axis to come into contact with the point of the bar magnet inclosed in the box, M, and the magnet will support its weight. Take hold of the south pole at O, and give the ball E a twirl in the proper direction, and it will rotate for some time, and all the while keep itself suspended to the magnet. Were the ball E spun on its axis with a cord, and then lifted up to the magnet, it would continue to move round on its axis for several minutes, and display a very pleasing effect. During the rotation of the ball, take hold of the handle, H, and give motion to the horizontal bar, B, and thereby cause the earth to circulate round the sun, S. By the obliquity of the top of the pillar, P, the earth, E, through the medium of the bar, B, will move in a corresponding oblique path round the sun. In the engraving, the vertical solar ray, P, of the sun, S, is directly over the tropic of Capricorn, and consequently our winter: remove the earth 90 degrees from this position, and the vertical solar ray will point over the equator. When at a point diametrically opposite, the solar ray will be over the circle I, or the tropic of Cancer, &c. In the bar, B, a wire, F, is fixed, and ascends a little way into a perforation in the sun; this causes the ball, S, to follow the motion of the bar, and thereby the solar ray, P, is always kept pointing to the surface of the earth, E, thus showing where the sun is vertical at different positions of the earth in its orbit. The apparatus, therefore, shows the diurnal rotation of the earth on its axis, (as if suspended on nothing); its annual and oblique motion round its orbit; and, consequently, the cause of the different lengths of days and nights throughout the year, and the beautiful vicissitudes of the seasons.

An observation of the following phenomenon first suggested the idea of causing a light ball to rotate on its axis. Provide an ivory, bone, or wood "tee-totum;" drill a hole in the top of the handle, to the depth of about a quarter of an inch, into which insert firmly a steel pin, with a tapering point; this done, make the tee-totum to spin on its axis, and, whilst it is in motion, apply the end of a bar magnet to the steel pin you inserted in the drilled hole, and you will find that the magnet, if strong, will lift up the tee-totum, which, notwithstanding, will continue in motion for a considerable time. When the tee-totum is made light, and caused to spin after the manner of French humming-tops, the tee-totum will rotate for a long time, suspended in space by the magnet.

Fig. 2.—As far back as the year 1823, I used to observe the rotation of a watch-glass on the surface of a looking-glass, &c. A few years ago, whilst engaged in completing the apparatus just described, I applied a globe of india-rubber to the watch-glass, by which means the ball was charged with motion. A few remarks will make evident the operation of this second apparatus. Let L L represent a looking-glass: describe a kind of an elliptical path on the surface of the glass, as *o o*, and delineate a sun in the centre, or what is better, (if you wish to have a glass entirely for the purpose,) erect an axle, and place on its point a large ball, say of 4 inches in diameter, to represent the sun. Next procure a common watch-glass, (the more convex its surface the better); put a drop of water or oil on the surface of the looking-glass, and place the convex point of the watch-glass on it; this done, gradually elevate the looking-glass, and the watch-glass will, at a certain point of elevation, become endowed with a rapid rotary motion; when the watch-glass is in motion, care must be taken to incline the looking-glass, so as to let the watch-glass rotate on a descending plane, which will easily be accomplished after a few trials. I have a thin india-rubber ball cemented with gum to the watch-glass, and on its surface a map of the world is delineated, as at E, fig. 2. This affords a pleasing and very simple illustration of the motion of the earth on its own axis, and of its circuit round the sun.

I am, Sir, your obedient servant,

E. HENDERSON.

London, December 20, 1842, 10, Powell-st., West.

[The astronomical apparatus, the two pieces of which are described in the preceding communication, will be familiar to many of our country readers, as that used by Dr. Henderson to illustrate his popular lectures, at different institutions, on astronomy, horology, and other branches of science. Altogether, it is the most original, ingenious, and complete collection of the sort which has ever come under our notice.—Ed. M. M.]

## DIVISION OF DECIMAL FRACTIONS.

Sir,—If the advancement of correct computation be one of your objects, the following remarks may not be without their use. I have always found that, if there be one rule in which more errors are made by beginners than in any other, it is that for the division of one decimal fraction by another.

The rule, as commonly given, is incomplete:—"Divide as in whole numbers, and make as many decimal places in the quotient as the number of places in the dividend exceeds that in the divisor." Let us apply this to divide 1 by ·001. Divide, as in whole numbers, $1 \div 1 = 1$. Now, there are in the dividend 0 decimal places, and 3 in the divisor; therefore, by the rule, we are to give $0 - 3$ decimal places to the quotient. *Algebraical* extension is necessary to carry this rule into practice, while poor arithmetic looks on, and wonders what they are doing with her. The rule can only be arithmetically applied by annexing ciphers to the divisor at pleasure; thus, 1·00000. Now we have $100000 \div 1 = 100000$, and $5 - 3$, or 2, is the number of decimal places, giving 1000·00 or 1000, the correct answer.

A rule ought to be given in which the calculator can readily tell *beforehand* where his decimal point will fall, in order that he may prepare accordingly for the requisite number of decimal places. I subjoin two rules which have this advantage; the first is the best, but the second is not without its interest.

*Rule* 1.—Move the decimal point to the right of the divisor, and carry the decimal point of the dividend as many places to the right as you did that of the divisor. Annex to the dividend as many ciphers as will make its decimal places the number you wish to have in the quotient; divide as in whole numbers, and cut off the number of decimal places prepared for.

Example 1.—To divide 17·9062 by ·00012 to 4 places of decimals. Change the divisor into 12, and carry the decimal point 5 places to the right in the dividend, giving 1790620·, which with four decimal places is 1790620·0000, which divided by 12 gives 1492183333, whence 149218·3333 is the answer.

Example 2. — To divide ·174 by 64217·99 to eight places of decimals. Here the dividend, properly prepared, is 17·40000000, and the divisor is 6421799. The quotient is 271, whence the answer is ·00000271.

*Rule* 2.—Let like numbers be those which are both greater, or both less, than unity; and let the number of places from the units place, *exclusive*, to the first significant figure be called the index of a number. ADD or *subtract* the indexes of the dividend and divisor, according as

they are UNLIKE or *like*, and make the result the index of the quotient; but remember always to put the decimal point one place more to the left than in the rule, whenever the first significant figures of the divisor (without reference to their local value) are higher than those in the numerator.

In the first example preceding, the indexes are 1 and 4, and the numbers are unlike; and 1+4=5, the index of the quotient, or there are five places preceding the units place. No rule is necessary to point out whether the index is that of more or less than unity, which is shown immediately by the values of the divisor and dividend. In this case the supplementary process is not wanted.

In the second example, the indexes are 1 and 4, and the numbers unlike; accordingly, 5 as the provisional index, or the first significant figure, would be in the fifth decimal place; but, because the divisor is greater in its commencing significant figures than the dividend, the first figure is in the tenth place.

Example 3.—In 1674·113÷127·29 the indexes are 3 and 2, and the numbers like, 1 is the index of the quotient, the supplementary process is not needed, and 1, the first figure of the quotient, means 10.

In the following list, we have in successive columns the divisor, dividend, index of divisor, index of dividend, index of quotient, value of first quotient figure, with an asterisk to denote that the supplementary rule is to be used.

| | | | | | |
|---|---|---|---|---|---|
| 783·196 | 2·1738 | 2 | 0 | 2 | ·002* |
| ·18497 | 2·1738 | 1 | 0 | 1 | 10 |
| 62384·17 | ·01923 | 4 | 2 | 6 | ·0000003* |
| 764·1182 | 75·298 | 2 | 1 | 1 | ·09* |
| ·007461 | ·08924 | 3 | 2 | 1 | 10 |
| 4416·8 | 248200 | 3 | 5 | 2 | 50* |

But no rule is so good as simple perception, to those who can perceive. All who practise this, or any other rule, should first endeavour to get such an idea of the answer as unassisted common sense will give; and the result will be, that rules will often be superfluous. All who have used computation often must remember instances in which rules, used carelessly or in absence of mind, led them to most absurd results, which were only detected by their own impossibility.

I am, Sir, yours obediently,

A TEACHER OF MATHEMATICS.

London, December 19, 1842.

ON MR. C. W. WILLIAMS'S PATENT FOR THE COMBUSTION OF GAS.

Sir,—As it may be desirable to have the means of distinguishing between my mode of consuming *gas* in furnaces, and those of others for "consuming *smoke*," I propose here to describe my own principle and practice, by reference to the only document which can be taken as legal evidence, namely, the enrolled specification. I have already stated, in a former communication, that in my "attempt to imitate in the furnace what was done in the Argand gas-burner, I obtained success by merely *reversing* the process; that is, instead of bringing the furnace gases in jets to the air, I brought the air in jets to the gas." Here not only is the object, sought to be accomplished, but the mode of effecting it clearly indicated; and this it is which has been made the subject of the patent.

The preamble of the enrolled specification states, distinctly, the object of the patent to be "*to cause a thorough admixture of the atmospheric air with the gas;*" and as it is inflammable gas, and not smoke, that is evolved from the furnace, our attention should be mainly directed to the producing this "thorough admixture," such being the *sine qua non* in effecting combustion, and preventing all or any of those gases from passing away either wholly unconsumed or partially so in the form of true smoke. It is manifest, indeed, that no atoms of air and gas can be chemically united in combustion, until they have first been mechanically brought into contact, or at least within the range or sphere of their respective attractions. The specification also states that this operation is intended "for the same purpose as air is admitted into the centre of the body of gas issuing from an Argand gas-burner;" and hence a furnace so supplied with air has been called an "Argand furnace."

The specification goes on to show how this "*thorough admixture*" may be practically effected, namely, "by introducing the air by means of small jets issuing from numerous apertures." The value of this mechanical contrivance is further illustrated by stating that, "where the required quantity of air is introduced in a body, through large pipes or orifices, the gas and the air (requiring time for mixing or effecting the necessary contiguity of their parts) have been found

not to be adequately incorporated until they had passed beyond the igniting temperature of the furnace." And again, "before the mixture had passed into the flues beyond the influence of the high temperature essential to ignition."

With respect to the *quantity* of air required, the specification furnishes the following particulars :—

"The carburetted hydrogen gases require, as the condition of their complete combustion, 1st, that they be intimately blended with an appropriate volume of atmospheric air, which volume varies with the nature of the combustible gas; and 2nd, that after having been so mixed with the air, the mixture be then heated to its temperature of accession, or be brought in contact with flame.

"Again, as one cubic foot of carburetted hydrogen gas requires two cubic feet of oxygen, or about ten cubic feet of atmospheric air, while one cubic foot of bicarburetted hydrogen (or olefiant gas) requires three cubic feet of oxygen or fifteen of air, to effect complete combustion,—these proportional volumes of air must be supplied, and so intimately blended, as to bring the combustible gases and atmospheric air within the sphere of their reciprocal chemical attraction."

Here the specification states, not only the quantity of air required, but the object of its introduction in a *divided form*, in terms which admit of no doubt, namely, the effecting such a degree of juxta-position among the atoms of the gas and air (that is, the being "*effectually blended*,") that chemical action may become operative, and chemical combination, which is combustion, be effected.

With respect to controlling the quantity of air so admitted, nothing is required practically beyond what the specification describes in the following words :

"The admission of air may be regulated *by slides*, as no more air should be admitted than will be found sufficient to consume the combustible gaseous and fuliginous matters, and prevent the deposition of the carbon and formation of smoke in the flues."

The specification, in conclusion, sums up in what is called "the claim," and which is generally referred to as the most explicit description of a patentee's rights, by stating that,

"I specially and exclusively claim as my invention, first, the use, construction, and application of the perforated air distributors, by which the atmospheric air is more immediately and intimately blended with the combustible gases generated in the furnace."

As to the situation, number, shape, size, or other modification of the apparatus for dividing the body of admitted air, and the use of pipes, plates, tiles, or other materials and contrivances for effecting its required division, these are matter of detail, and almost of indifference. To prevent cavil, however, in such details, the specification contains the usual saving clause, as follows, viz.:

"As I do not confine myself to the particular number, dimensions, or situation of the several parts here described, they may be varied to suit the constructions of furnaces and boilers, and the circumstances under which they may be placed, and which may be effected by any competent persons; —these, my inventions, being applicable and intended to apply to all descriptions of furnaces, stoves, or boilers, where coal is consumed."

In the specification, I have, as is customary, described "one mode of applying my invention to land boilers," and selected one which was best adapted for displaying the peculiar effect produced when air is made to enter in thin films, or in a divided state. In this example the air distributors are placed in a conspicuous situation, and one most favourable for ocular inspection. The effect of dividing the air on its approaching the gas is there so palpable as to carry conviction to all who see it. In fact, without this *visible* mode of exhibiting the effect, I foresaw I should be discredited, the chemical action denied, and the whole classed among the numerous "smoke-burning" expedients, whose patentees allege that "smoke is burned," and other effects produced, but which they can neither prove, visibly or chemically, and where in truth the gas is often not consumed, but merely rendered invisible.

The specification embraces other useful objects connected with furnaces. These, however, need not here be referred to. The main features, then, may thus be recapitulated:—1. The introduction of the necessary quantity of air. 2. The incorporating or mixing this air with the gases before it be too late, that is, before they are cooled down below the required temperature. 3. The effecting this incorporation by any of the ordinary contrivances which will cause the air to enter in a divided form, the object being to

present enlarged surfaces for mutual contact, and, consequently, enlarged surfaces for chemical action between the air and the gas.

I may now say a word as to the application. On this head, the experience of every practical man must satisfy him, that, as the forms, characters, and objects of furnaces differ, so must the situation and adaptation of the means of admitting and dividing the air be also varied; and it is not for a patentee to describe all possible modes or situations of application or adaptation. Again, as it is found by experience, that even the peculiar character of different kinds of fuel vary in the quantities and character of their gaseous formations, so will they vary as to the length of time required, or the difficulty in effecting the requisite mixing or diffusion of the gas with the air. Were it convenient, perhaps, the most effective mode of introducing the air and applying the principle would be, by extending the range of apertures along the entire roof and sides of furnaces, and even along the flues. In ordinary boilers, however, this would interfere with the situation of the water. In such, therefore, we are necessarily limited to the two ends of the furnace, and to these have I hitherto recommended the admission of the air to be confined in steam boilers.

In the case of reverberating furnaces, or those for heating large iron plates, a greater range is available; and here the orifices or apertures may be placed along the roof and sides, as well as at both ends.

As stated in my former communication, the object and practical application of this patent is as well defined, and as distinguishable from others, as the Argand gas-burner, with its numerous apertures, would be from that with a single large jet. The only difference to be reconciled, in comparing the Argand lamp and the Argand furnace, is, that their respective actions have to be *reversed*, since it is the air which issues in a divided state, and by suitable apertures, to the body of the gas, in the latter; while in the former, it is the gas which issues in a divided state to the air—the object to be effected, however, being identical in both, namely, enlarged surface, or atomic contact and diffusion, to as great an extent, and as rapidly as possible. On this head, I need only repeat the observation of Professor Brande, when he says, "the effect is exactly the same, only, in your furnace, you *invert* this ordinary state of things, and use a jet of air thrown into an atmosphere of inflammable gas."

I am, Sir, &c.,

C. W. WILLIAMS.

Liverpool, December 22, 1842.

WOOD PAVING—COL. MACERONE'S FLYING STONE DRIVER—WATERPROOF COMPOSITIONS—FILTRATION—LIGHTNING CONDUCTORS, ETC.

Sir,—In your No. 1006 there is a letter on wood pavement, by "Junius Redivivus," cogent, as are all from him, but which requires a remark or two from me. He says, or implies, that my suggestion and remarks on wood pavements appeared in 1833, whereas, the work he alludes to was only *a second edition of that printed in* 1824. "Junius" also forgets to mention my plan of mere mechanical pressure on the subsoil, and then upon the wood or stones. The machine to perform this office in the most brief and effectual manner, you, Mr. Editor, have christened by the name of the "flying stone driver;" and you judiciously add that, whether the pavement be of wood or stone, my plan is by far the most effective and economical. In fact, any person of common sense, who will observe and reflect, cannot but arrive at the intimate conviction, that all the complicated, tedious, vastly expensive processes of laying gravel, broken granite, or concrete, under the wood or stones, and then grouting, are utterly useless, supererogatory, and inconvenient, compared with my merely mechanical, cheap, and perpetually enduring plan, by which the pavement must necessarily become more dense and level the longer it is used. All this I have demonstrated in my pamphlet called "Hints to Paviours," and in many articles in your Magazine, particularly, I think, in 1838. As many of your readers of the present day may not have seen my said work or letters, I hope you will allow me to reiterate a mere outline of my system, and patent machine. I construct a square or circular horizontal frame of wood, six or eight feet diameter, mounted upon four or more castor wheels, which turn in every direction. Upon this frame are mounted two upright square spars, exactly like those of a pile driver, but only ten feet high, or less. At the top of these spar guides is a grooved pulley wheel, at least a foot in diameter, over which passes a rope, to the lower end of which is attached a block of wood strongly hooped with iron, similar to a butcher's large block, which

may be either square or round. In the centre of the basement frame is a hole for the block to fall through. Six or eight men standing round the circumference of the stage, simultaneously pull up the weighty block by as many ropes attached to the top of the main one, then suddenly letting go, the block falls with a great momentum on the substratum to be compressed, and afterwards on the stone or wooden pavement. After two such powerful compressions, it must be passing strange indeed if a perfectly level surface is not preserved, maugre the rolling of the heaviest wagons; but *should* any inequalities appear, the *protuberances* alone must be attacked by my machine, and there is your pavement fixed for ever. In the case of having to take up any part to lay water or gas pipes, the machine will, in a few strokes, restore it to an equal density with the rest. A watering cart will indicate the least protuberances to be knocked down. One of my declared and obvious objects has been economy, in making a *perfect* pavement with the stones already in use. But the paviours have, for years past, been persuading the lieges to have new stones, and larger and larger, which, notwithstanding all the fuss of gravel, then granite, then compost, then grouting, have produced pavements in Cheapside, the Strand, Holborn, Oxford-street, &c., which, after a few days, became as even as the surface of the Thames in a gale of wind! But then—hurra!—the job has had to be done over again in a few months, besides the *constant* picking up of holes, &c. "Junius" recommends the wooden blocks to be laid at an angle of 45°. I do not see the utility of that. Square blocks are more simple and cheap. The grooves cut on the heads can only serve as deposits for wet and mud. The surface grouting when *set*, must soon be reduced to powder, whether between wood or stone, by the vibration of the carriage wheels. In 1824, in writing on wood pavements, I recommended hot coal tar to be poured over the surface when dry. I leave you, Mr. Editor, and your readers, to reflect on this. But *durability* is, perhaps, no object with the paviours. It would require a pamphlet to point out the egregious errors of the present and past systems of paving; so I must be content with these brief and disjointed remarks, which, notwithstanding the importance of good, cheap street paving, will, I know, be no more attended to by the paving and paying people than they have been during the last eighteen years.

In your last Number I read a letter of your intelligent and benevolent correspondent Mr. Wm. Baddeley, in which he kindly eulogises my cheap mode of preserving boots and shoes, and keeping out the wet. He also mentions an "improved" method of applying my simple waterproof composition, thought of by your agent at Hamburgh, that is, of pouring the hot melted composition into the *inside* of the boot, &c. I have applied that method to my own boots and shoes for the last thirty years; but when I have ventured to do so by the boots and shoes of my wife and children, they have made an outcry about its soiling their stockings, and resisted my touching them at all. But I would beg Mr. Baddeley to remember that a very important part of a boot's construction is the *external* sewing of the sole to the welt, and *there it is* that an abundant application of the hot composition is to be poured in. If a bright polish is desirable immediately, a solution of bees'-wax in spirits of turpentine, subsequently applied externally, and suffered to dry for a day or two, will provide it. Whilst shooting or fishing in the Pontine marshes, and the other *maremme*, or sea side marshes, of the Mediterranean, we use "swamp boots," which draw up to the "fork" of the thighs. The shooters, and fishers, and sportsmen there, grease them with lard. So did I; but I soon found that this coating became rancid, and rotted both the leather and the sewing. Hence, in 1807, I added the powerful antiseptics, rosin and wax, and found a vast difference in all the results. I often stop to advise labourers in the streets to keep their feet dry, and make their shoes endure thrice the usual time by so cheap an application. Many, many such have subsequently thanked me. Three pairs of boots properly so treated, have lasted me five years.

Mr. Baddeley is quite correct in his statement of the power of a small admixture of rosin with the oil, preventing the oxidation of the brass or copper works of machines to which it is applied. Several engineers have adopted this my suggestion many years ago, and found it to answer.

Mr. Baddeley humanely and kindly asks why the wood paving gentlemen do not present me with some sum of money in consideration of my older and continued advocacy of wood paving? Alas! I have told them how *I* could lay down *their* pavements at one-fourth of what they now cost. But the sequel is, nothing! The stone paviours say that, without the continual renewal of the pavements, and the new stones, their "*occupation's gone.*" They will not see that their contracts for "*keeping in repair*" could, by my means, be fulfilled at one-tenth or less of the cost of digging up, relaying, &c.

To return, for a line or two, to my simple application to boots and shoes, I must state that, when, about two years ago, I fell into want through the suicide of my last

steam carriage company, I felt anxious to obtain *any* employment. I knew that I *could* do good service at Woolwich; but how to obtain any patronage or introduction? So I wrote to Lord Hill, offering to render all the shoes and boots of the army, or any part of it, waterproof, and thrice as durable, at twopence a pair. I also proposed to render any portion of the parade behind the Horse Guards, whereon the troops tramp in the wet in rainy weather, as dry and hard as a marble pavement, at twopence a yard square, by merely pouring over it, when dry, hot coal tar, as I had done to the garden walks of Mr. J. R. Bell, at Blackheath, in 1816, and which endure to this day,—the prototype of all *bituminous* roads. "Lord Hill presents his compliments to Colonel Macerone, but cannot give him any employment!" Here you see, Mr. Baddeley, was a stopper to my waterproofing proposal, and to my twenty-seven years old bituminous surface. A Frenchman named Polonceau immediately obtained a contract to treat the paths along Whitehall and Parliament-street with the same bituminous application, at ten times the price which I had proposed to Lord Hill.

Now I have my pen in my hand, a word on the filtration of water, which subject has lately been much mooted in the *Mechanics' Magazine*, and other periodicals. I do not understand, from all that I have read, that any filtration is thought of, but that of freeing the water from all impurities which are *mechanically* suspended in it; such as is well performed by sandstone filters called "*dripstones*." Now it is of the utmost importance that the benevolent men who advocate the filtration of our filthy, putrid Thames water, should seriously bear in mind, that mere *mechanical* filtration and *chemical* filtration are very different things. Any salt, or other substance perfectly soluble in water—for example, salt or white sugar—will pass through the dripstone filter as well as the purest water. But not so with the chemical filter, of which I will give an instance.

My friend Giovanni Dall' Armi, who introduced into Italy and France the art of lithography, in 1806 or 1807, constructed, in 1808, a *chemical* filter, composed of a cask with a perforated diaphragm, over which was laid a thick stratum of pounded charcoal, and over that a layer of sand; then broken bricks, then a large sponge, or thick haircloth. On the 27th of September, 1813, I attended an experiment made at the hospital called "*Degli Incurabili*," at Naples. In this place there were several stone cisterns to macerate skeletons, so as to clean the bones. Each cistern contained two or three skeletons, and the water had become brown and putrid. The investigating party consisted of the celebrated physician Cotugno, Bruno di Amantea, Angelo della Leonessa, Sementini, the Prince Colonna, the Duke of Cassano Serra, and my co-pupil Don Michelino Serra. A portion of the fœtid water was put into the charcoal filter of Dall' Armi, and, after it had passed through it, the entire party sipped it from a goblet, in which it was as clear as crystal, and equal in taste to the best spring water, barring the flatness which generally belongs to filtered water, from the deprivation of the air it previously held in solution.

Lightning conductors have recently been brought into notice because of the injury to St. Martin's church steeple, and the ignition of two ships by the electric fluid. On this subject I really do not know what to say. If people have not listened to the demonstrations and warnings of the great Benjamin Franklin, how can *I* expect that my feeble voice, repeated and re-echoed as it may be, will ever be heeded? But, as "facts are stubborn things," I will mention one or two for the consideration of your intellectual readers. When I happened to be at Rome in 1811, I found that St. Peter's Church, isolated in a vast plain, was very frequently struck by lightning, during the thunder storms which are so frequent there in November and December. I was acquainted with General Miolis, the imperial governor of Rome, with the Count Norvince de Monbreton, minister of police; M. Lorbin Janson, inspector of the museums, &c., and induced them to form themselves into a committee of investigation. I had seen how the copper ball had been riddled by the lightning, and several great stone steps dislocated and cast abroad. The process of these electrical actions induced the French authorities of Rome to place conductors all over the church; one fifteen feet above the cross, with a point of pure gold, and others at every angle of the edifice. They were all above an inch in diameter, and supported by perforated pieces of marble let into the walls. It is a great increase of efficacy in lightning conductors for them to have their summits terminate in many points instead of one. Such will generally draw off the electric fluid quite silently, without any discharge or perceptible corruscation. If a branch of heath, broom, or a common birch broom, be approximated to the most powerful and fully charged electric machine, all the electric fluid will be drawn off quite imperceptibly. Thus it is that the cypress, the laurel, and some other trees, have been deemed "sacred," and lightning-proof, by the ancients, because their innumerable sharp pointed leaves prevent any electric discharge. Electricity is the main supporter

of vegetable life; in some cases, I am convinced that it is the only one; whereas, in some of the lower orders, such as the Parasiti and the Fungi, it seems to be less needed. In the "lower orders" I do not include the *Gramminæ*, which, I could show, are highly affected by the electrical state of the atmosphere. But this disquisition is not to my present purpose, and would lead me to a great length of disquisition, which I shall detail in my continuation (if I live) of the "Electrical Theory of the Universe," three papers on which appeared long ago in your omni-important miscellany.

I have the honour to be, Sir,
Your obedient servant,
F. MACERONI.

P.S. Tubes form better conductors than solid bars, because they have two surfaces. The conductors in this country are not one-tenth of the proper size. Ships should have chains proceeding down the shrouds into the water.

THE INVENTION OF STEAM DREDGING, AND THE LATE RICHARD TREVETHICK.

Sir,—As considerable doubt still hangs over the first application of steam to dredging purposes, I send you a few particulars which will throw some light upon the share which the celebrated Richard Trevethick had in this work. These particulars, it must be admitted, are not so satisfactory as could be wished; but, considering the obscurity which is thrown round the origin of this invention by all the writers in the Encyclopædias and other standard works, any contribution to the very scanty information which is already published on the subject will, I think, be interesting to your readers. The particulars I have to furnish are contained in the following extracts from a letter written by Mr. Edward Biggs, of Igtham, in Kent, who was for many years the principal manager of the extensive dredging operations carried on by the late John Hughes, in the river Thames, for the Corporation of the Trinity House, the East and West India Dock Companies, and other public bodies. I am your obedient servant,

AN ENQUIRER.

*Extract from Mr. Bigg's Letter.*

"In the year 1806, I erected a steam engine on board the ballast lighter *Brunswick*, burden 60 tons, for Messrs. Hughes, Bough, and Mills, which was employed to deepen the river Thames, at the East India Moorings, Blackwall; and in the early part of 1807, my late friend, Mr. Richard Trevethick, came on board and looked at the machine, and was afterwards engaged by Messrs. Hughes to erect a dredging engine on board the *Blazer* gun-brig, a vessel about five-times the burden of the *Brunswick*. When it was finished, or, as it was then thought to be, Mr. Hughes, the late Mr. D. Vaux, engineer of the City Canal, and Mr. Mills, came to me on board the *Brunswick*, at the East India moorings, and informed me that the *Blazer* dredging engine was defective in some parts of its machinery, as it could not perform the work it was intended to do. They then wished me to go on board the *Blazer* and examine it, but I strongly objected, saying, I did not like to interfere with any other person's business; Mr. Hughes then said that if I would not go on board to see what was wrong, the vessel must be put into Perry and Wells' dock, as it was a great expense to keep her on the river with two sets of men, when she was scarcely doing any work. Mr. Hughes then showed me a calculation of the expense of the *Blazer* dredging engine, and pressed me very much to go on board and make the necessary alterations, and I then complied with his request. The *Blazer* was after that time employed in finishing Mr. Hughes' work at the East India moorings, and afterwards for raising gravel near Westminster Bridge, at the entrance to the docks, and at various other places in the river.

"Mr. Trevethick was also engaged by Messrs. Hughes at the same time, to erect a dredging machine on board the *Plymouth* bomb brig, lying at Limehouse Hole; but when they found the *Blazer* engine defective, they requested me to go on board the *Plymouth*, and make a report to them on the subject, which I did; and then the boiler, engine, framing, &c., were taken out of the vessel immediately. Messrs. Hunter and English, of Bow, were then employed to erect a dredging machine on board the *Plymouth*, which vessel was first set to work to good effect, at Woolwich Dockyard.

"If my late friend Mr. Richard Trevethick, were now alive, he would, I know, assent to every word I have written on this subject. For several years before Mr. Trevethick left England to go to South America, we were very friendly indeed; he frequently coming to the works where I was engaged, and whenever I could spare time I used to spend a day very pleasantly with him in London; he pressed me very much to go with him to South America.

"Mr. Trevethick was a very ready clever mechanic; he died a few years ago at Dartford, in Kent, 13 miles from this place.

"The late Mr. Rennie, and the late James

Watt, came on board the *Brunswick* in 1807, and they afterwards built a dredging engine for the fens in Lincolnshire."

## MR. DREDGE'S SYSTEM OF BUILDING SUSPENSION BRIDGES.

Sir,—I am particularly obliged to you for the able vindication of my claims in your notice last week of Professor Moseley's "Mechanical Principles of Engineering and Architecture," the more so, as but for that, I might not have known there had been any occasion for it, not having seen the work itself. Your remarks may probably seem to render any thing from me unnecessary; yet, nevertheless, I will venture to say a few words, for which, perhaps, you will allow a space in your Journal. As I am still without the advantage of having seen the Professor's work, all my present information must be considered derived from your review.

From this, it appears that Mr. Moseley "has demonstrated that it is false in principle to have a uniform section of iron for the chains of a suspension bridge, and that if it is required to build a bridge of uniform strength, and therefore, with the greatest economy of material, the area of the section of the chains should increase from the lowest point towards the main points of suspension." It also appears, that the Professor is very particular in pointing out in his Preface, that this beautifully simple principle is introduced *for the first time.*

As far as his demonstration of the fallacy of the old principle of suspension goes, I thank him for the trouble he has taken; because, just so far as his formulæ are correct, just so much is he assisting me in establishing my views on the subject. But, he may rest assured, he will find very few, if any persons ready to give him that credit he so anxiously seeks, for introducing a principle which was mooted and made public before his book was written, or indeed "thought of;" for, notwithstanding the Professor's assertion in his Preface, I deny that he has the slightest claim to any merit for that which I alone invented and introduced. I do not suppose that Mr. Moseley wishes his readers to think him the inventor of the principle he describes: I therefore request, and in common fairness have a right to expect, that he will state whether or not he has ever seen this principle of suspension carried out in practice, or any description of it, but such as has come either directly or indirectly from me? Or whether he thinks the varying section of the chains, and the use of the oblique rods, were ever thought of until I put them in practice across the Avon, at Bath? If he can trace his information to other sources than myself, I will thank him to do so. If he cannot, why then, as a necessary consequence, I being a stranger to Mr. M., must have made the subject public before it could have come to his knowledge.

There is another point I shall just notice. The *note*, runs thus:—

"This variation of the section of the chains is exhibited in a suspension bridge recently invented by Mr. Dredge, *and appears to constitute the whole merit of his invention.*"

The careful reader will at once perceive that Professor Moseley here allows my invention to be all he before demonstrates to be so beautiful and essential in suspension bridges; but he will also see that he does it with a bad grace, wishing to conceal the merit of the inventor as much as possible from the observation of his readers. I will not attempt, for I cannot divine his reason for such conduct, unless it is to arrogate to himself, by borrowing and building on other men's ideas, a merit that is not his own. But of this meanness, without sufficient cause, I would not willingly accuse any man, nor will I Mr. Moseley until I have seen his work.

Before I conclude, I beg to inform Mr. Moseley, however, that the tapering the suspension chains is not the only merit I claim for my invention. So far from that being the case, a variation in the section of the chains is merely a consequence of that part in which the chief merit lies. What I allude to is the arranging of the suspending rods, which I place in an oblique instead of a vertical direction, with respect to the horizon. This it is which has all along bothered so many of the mathematicians and engineers, and this it is alone which allows me to taper the chains of a suspension bridge to the extent I propose, and have carried out so repeatedly in practice. If Mr. Moseley has not taken the effect of these rods into his calculations, I fear I shall not receive that assistance from the Professor's labours I at first calculated upon.

Let me request of Mr. Moseley to come forward and establish the position he has taken in his work, and, by so doing, disprove mine; and I hope he will have a sufficient regard for his reputation as a man of science to clear it from all appearance of the stigma which the borrowing of another's ideas, without a sufficient acknowledgment, would infallibly cast upon it.

I am, your obedient humble servant,

J. DREDGE.

[We regret the warmth with which Mr. Dredge expresses himself; but, at the same time, we cannot but feel that it has its excuse. Professor Moseley will no doubt do what is right in the matter.—ED. M. M.]

### APPLICATION OF WIRE-ROPE AS A LIGHTNING CONDUCTOR—MR. ROBERTS IN REPLY TO MR. HILL.

Sir,—In gentlemanly society it is not tolerated for one individual to say to another, "Sir, I charge you with stating a falsehood; I know there may be proofs you are correct in your statement, but it suits my purpose to maintain that what you assert is not true, and I will therefore not take the trouble to search for proofs of your correctness, and my misstatements." This, in effect, is Mr. Hill's letter of the 12th. What the practice may be amongst his intimates I know not, and have no wish to know.

Your readers will find in the Report of the Committee on Lightning Conductors, which sat in 1839, sufficient proofs that I am known to the Lords Commissioners of the Admiralty, and that the plan now claimed by Mr. Hill, for Mr. Smith, is indisputably mine.

I am fortunately too much occupied with matters of importance to lose time in further discussion with Mr. Hill.

Yours, &c.,

MARTYN ROBERTS.

[We have referred to the Parliamentary Report on Lightning Conductors, mentioned by Mr. Roberts, and see in it sufficient to induce us to regret extremely that our columns should have been made the medium of the depreciatory observations of which he very justly complains. It is established by the documentary evidence attached to that report, that Mr. Roberts proposed the application of wire rope as a lightning conductor, in a paper read before the Electrical Society, on the 24th of June, 1837—that he brought this plan most pointedly under the attention of the Admiralty in May, 1839—and that, when a royal commission was subsequently nominated to enquire into the subject, he was applied to by them for his advice upon it, and gave it frankly and unreservedly. Of Mr. Smith, all this while, we see no trace. The truth is, that Mr. Smith's merit consists solely in latterly supplying, as a manufacturer, the wire rope which Mr. Roberts first suggested should be applied to the purposes of electrical conduction; and as there seems now every appearance that wire rope conductors will be those universally preferred, we trust Mr. Roberts will not go without his reward.—ED. M. M.]

### THE "MAGICIAN" STEAMER.

We have been favoured with the following details of the experiments made with this vessel, alluded to in our brief notice of the 10th instant.

The experiments were made on the 16th, 17th, and 18th of November. The vessel left Woolwich about 10 o'clock A.M. on the 16th, and in about half an hour afterwards passed the *Rhadamanthus*, which had left Woolwich at 9 o'clock. At about half-past 11 o'clock she stopped for a few minutes at Gravesend, and then proceeded, with a strong breeze ahead and adverse tide, and at a quarter-past 1 o'clock passed the *Nore-light* vessel; arrived at Ramsgate 25 minutes past 4 o'clock, when the weather was so severe that none of the London steam-vessels arrived during the course of the day. The weather continued so boisterous on the 17th that the *Widgeon* steam-vessel was under the necessity of putting into Ramsgate harbour at an early hour for shelter. The *Magician*, however, left Ramsgate shortly after 11 o'clock A.M., the wind blowing at the time a strong breeze from the eastward, and at 53 minutes past 12 o'clock passed Dover Pier, with a very heavy sea running. At 24 minutes past 1 o'clock, when opposite Folkstone, she put back for Ramsgate, where she arrived at 44 minutes past 3 o'clock.

On the 18th the *Magician* left Ramsgate at 17 minutes past 10 o'clock A.M., with flood tide, and at 14 minutes past 3 o'clock P.M. arrived off Woolwich. The average speed of the engines from Ramsgate to Woolwich was 35½ revolutions per minute, length of stroke 3 feet 6 inches, height of steam gauge 7 inches, height of barometer 28¾ inches. The boilers are constructed on the tubular principle, very small, and generate steam well. The consumption of coal was about 6 lbs. per horse power per hour, and the vessel was found to be extremely easy and dry in a heavy sea. The average speed of the vessel from Ramsgate to Woolwich, the distance being estimated at 85 miles, in five hours, was equal to 14 knots, or *seventeen statute miles, per hour!!!*

We must not forget to add, that the *Magician* is fitted with a condensing apparatus on the plan of Mr. Howard.

### ABSTRACTS OF SPECIFICATIONS OF ENGLISH PATENTS RECENTLY ENROLLED.

JOHN JAMES BAGGALY, OF SHEFFIELD, SEAL-ENGRAVER, *for certain improvements in making metallic dies and plates for stamping, pressing, and embossing.* Patent dated January 22, 1842.

A mould of the design to be embossed is first to be obtained in bas-relief, from which a sulphur cast in alto-relievo is to be taken. A reverse mould, called a "hub, or sinker."

is then taken from the sulphur cast, of about the thickness of an eighth of an inch, which forms the matrix of the die required. A steel plate is next made red-hot, on which the hub or sinker is placed, and, by repeated blows, the steel is pressed into all parts of the matrix; so that, on cooling, the steel plate exhibits a correct fac-simile, in relief, of the required design. The die thus produced requires to be cleaned off, technically called "got up," and is then soldered to a bed of cast-iron. Instead of a steel plate, annealed malleable iron may be used.

The claims are, 1. To the producing from flat plates of steel, or other metals, the subject of a required die by the means above described.

2. To casting the said subjects from a matrix, and afterwards treating such metals as above described.

3. To the attaching such stamped dies to cast-iron blocks by means of solder.

RICHARD BEARD, OF EARL-STREET, BLACKFRIARS, GENTLEMAN, *for improvements in the means of obtaining likenesses and representations of nature, and of other objects.* Patent dated March 10, 1842.

Mr. Beard's improvements consist in *colouring* the pictures obtained by the Daguerreotype process. After a picture has been obtained, a tracing of it is made upon glass, and from this copy on glass as many other copies are taken in tracing-paper as there are different colours intended to be used. From the tracing appropriated to each colour those parts are cut out which are to be represented of that colour, so that, when superposed on the face of the picture, it covers all but those places where the colour is to be applied, (exactly in the same way as in stencilling.) The colours are applied in the state of an impalpable powder, mixed with just as much gum arabic or isinglass as suffices, when the colours are breathed upon, or otherwise gently heated, to fix the colours.

ALFRED JEFFERY, OF LLOYD-STREET, PENTONVILLE, GENTLEMAN, *for a new method of preparing masts, spars, and other wood, for ship-building and other purposes.* Patent dated April 15, 1842.

This method consists in the application of a composition or glue for joining wood, which is stated to possess the advantages of being insoluble in water, and being more elastic than any glue heretofore in use. When a very elastic glue is desired, the patentee dissolves 1 lb. of caoutchouc in 4 gallons of crude naphtha, frequently stirring the solution, until the caoutchouc is well dissolved, which will be in about ten or twelve days; to this is added gum or shellac, in the proportion of two parts to one of the naphtha. The composition is then put into an iron vessel, to which heat is applied, and well stirred until all the ingredients have become thoroughly amalgamated; it is then drawn off, by means of a tap, on to slabs, and allowed to cool, after which it is cut into pieces, ready for use. When a less elastic glue is required, it is composed of 1 part of naphtha and 2 parts of gum or shellac. Previous to using, the glue must be heated in an iron pot to 250° Fahr., care being taken that the surfaces about to be joined are perfectly dry.

The claim is to the use or application, in preparing masts, spars, and other wood for ship-building and other purposes, of a glue insoluble in water, and more elastic than the glue in ordinary use.

MARC CARLOTTI, OF LITTLE ARGYLE-STREET, REGENT-STREET, GENTLEMAN, *for certain improvements in the construction and manufacture of boots, half-boots, shoes, clogs, and goloshes.* Patent dated April 8, 1842.

Wooden soles are introduced between the outer sole and lining of the boot, which are calculated to protect the feet from wet, and to effect a saving in the wear and tear.

The improvements in clogs and goloshes consist in substituting springs for the ancle-straps now used.

GEORGE HOWE, OF MANCHESTER, GENTLEMAN, *for certain improvements in machinery or apparatus for sweeping and cleaning chimneys and flues.* Patent dated May 9, 1842.

Two methods of chimney-sweeping are described. The first consists in effecting the operation by means of a brush and chain; the chain passing over a pulley fixed at the top of the chimney, and being attached by its two ends to two small windlasses in the fire-place, upon and from which it is alternately wound and unwound. The second method consists in bringing down the soot in a chimney by means of a sudden concussion of the air within it, which is to be effected by "hermetically sealing" the fire-place, inserting a cylinder and piston, &c.

JAMES ANTHONY EMSLIE, of Newcastle-on-Tyne, C.E., *for certain improvements in pumps.* Patent dated June 9, 1842.

These improvements relate chiefly to the class of pumps employed for the raising of water from mines, through the agency of steam power. The patentee supposes the case of water being raised from a depth of seventy-five feet. He first takes a length of tubing, to the extent say of twenty-five feet. Upon the top of this tubing, he places a box, of dimensions suitable to the quantity of water to be delivered at each stroke, which box is fitted with three valves; one valve being at the head of

the tube, for preventing the water from returning, at the time the second or delivering valve is open; and the third valve being made of a floating substance, with a rod attached to it, so that, as the water rises in the water box, it may become elevated thereby, and prevent the water rising in the air tube. From the water reservoir, another length of water tubing, similar to the first, ascends to a second box, which is fitted up in all respects similar to the former. The air tube passes through or round the reservoir, and round the water box, into a second air tube ascending from the second water box. A third length of water tubing ascends from the reservoir last mentioned, and has at its head a water box, fitted up in all respects similar to the boxes before described, with this exception—namely, that instead of having a reservoir, a spout is attached for carrying and delivering the water in the direction required. A small branch pipe, from the third water box, forms a junction with the air tube below the cylinder; so that, on the elevation of the piston in the cylinder, caused by the vacuum created under the piston in the steam cylinder, and also by the pressure of the atmosphere, in excess of the pressure required to support the column of water, in one lift, the air in all the boxes is thereby acted upon, and removed into the air tubes and cylinder; and water, or other liquid, takes the place of the air removed from the boxes. The theory of the action of this portion of the stroke of the engine, is stated to be founded upon the well known law of the pressure of fluids. Thus, assuming the pressure of the atmosphere to be 15 lbs. per square inch, and that this pressure will support in *vacuo* a column of water of nearly thirty-four feet in height, it follows that if the height of the column be fixed at twenty-five feet or thereabouts, there will be, on the head thereof, a surplus pressure of about 4½ lbs. on the square inch, which is sufficient, taking all the lifts together, to overcome the friction of this portion of the stroke of the engine. The remaining portion of the stroke—that is, the downward stroke of the piston, or the stroke for delivering the water—is produced by admitting steam, at or about the atmospheric pressure, into the cylinder, under the piston, by the steam port, which, causing the piston to descend in the air cylinder, restores to the surface of the water, in each of the water boxes, a pressure equal to that of the atmosphere; the effect of which is, owing to the tendency of the water to gravitate, that the water is ejected at the delivery valve as before mentioned. A pipe is connected from the waste port of the steam cylinder, to the top of the cylinder, through which pipe, on reversing the valves, the steam flows, and is acted upon, and condensed by, a jet of water from a rose, and on the piston attaining the summit of its stroke, ejected at the port into the tube fitted with a water-tight valve. The cylinders are connected at their tops by a pipe, which keeps on the surface of each piston an equal amount of pressure, the cubical contents of each of the cylinders being, at least, equal to the cubical contents of the whole of the water boxes employed. The pistons are fitted with rods attached to a working beam, having parallel motions at either end, from which beam the valves may be worked by means of tappits. The steam port is connected with a steam boiler, proposed to be worked at high pressure, so that the steam may be wire drawn, and enter the cylinder at a low degree of elasticity. In starting this apparatus, it is first necessary, by means of an air pump, which can be applied to each of the water boxes in succession, to exhaust the air from all the water boxes that the water may rise therein, the admission of the steam in the cylinder under the piston, causing the descent of the water in the boxes, and thereby obtaining the first portion of the stroke, when its condensation, producing a vacuum in the cylinder, the air returns from the boxes, in consequence of the surplus atmospheric pressure, and performs the remaining portion of the stroke. The engine might also be started by filling the reservoirs and valve boxes with water, and employing steam at a somewhat higher pressure, till the whole of the water tubing was filled with water.

"*Claim.*—In the invention of this apparatus, I do not limit myself to any size or form of tube, either longitudinally or transversely, nor to any particular dimensions or forms of valves, boxes, cylinders, rods, or other parts; nor do I confine myself to the precise figures or shapes, as the same may be varied as found requisite; nor to the use of any particular metal, or other material, for the construction thereof respectively; nor to any certain number of lifts between the well and the cylinders, nor to the exclusive use of steam. I do not claim, as my invention, the raising of water without its entering the working barrels of pumps, neither do I claim the invention of raising water by means of a series of lifts, by means of air-tight tanks or cisterns. But I do claim the principle of the general arrangement and adaptation of the machinery described, and the peculiar application of the sources of its action, as set forth in the above statement thereof; and as the general arrangement, or some portion of it above

described, without the steam cylinder and its appurtenances, under some circumstances, may be worked with advantage by water, manual, or other power, I also claim for my invention, or any portion or portions thereof, the use or application of such power, or as many powers, as can be so applied."

Henry Bewley, of Dublin, Licentiate Apothecary and Chemist, *for an improved chalybeate water*. Patent dated June 23, 1842.

Iron, as is well known, is already extensively used for medicinal purposes, prepared either according to the directions contained in pharmaceutical works, or according to the extemporaneous prescriptions of medical practitioners, or as it exists in natural chalybeate waters. But of the artificial preparations of iron in common use, some are liable to rapid decomposition, and are consequently of varying and uncertain strength, while others are insoluble till they meet with an acid in the stomach, and therefore act with more or less efficacy, according to the quantity of that acid. Some, again, are, from their irritant properties, liable to disorder the stomach, while most are nauseous to the taste. The natural waters, especially characterized as chalybeates, are also very generally subject to speedy decomposition, so that, though drank with advantage by invalids at the sources, they can seldom be transmitted as an article of commerce to distant parts, without having their efficacy impaired by transport or keeping. A consideration of these circumstances has led to the composition of the improved chalybeate water, which is the subject of the present patent; and which, judging from numerous testimonials that we have seen from the highest medical and chemical authorities of London, as well as Dublin, is likely to prove very extensively useful. Mr. Bewley's chalybeate is particularly distinguished from all others in this, that it contains the iron in a state of *complete solution*, so that there is no obstacle whatever to its ready absorption. It exerts a tonic yet mild effect on the system, and is rendered, by combination with carbonic acid gas, as highly effervescent, as the best natural chalybeate waters, and more so than the great majority of them. The manner in which this improved chalybeate water is prepared, is described to be as follows. "I dissolve in a mixture of about 10 pints of water, and 3½ oz. by weight of good commercial sulphuric acid of the specific gravity of 1·840, or thereabouts, (the said mixture being contained in a stoneware or porcelain basin or capsule, or other convenient vessel, set in a sand bath), one pound of the crystalized sulphate of iron, such as is sold by manufacturing chemists for medicinal purposes. I raise the heat of the solution to the boiling point, and then add at intervals nitric acid of ordinary commercial strength, of the specific gravity of about 1·340, stirring frequently till the solution ceases to give off vapours of an orange colour, which is a well known indication of the iron having attained the state of peroxide. I then pour this peroxidized solution into about ten gallons of water, and add to this mixture (stirring it at the same time) water of caustic ammonia, (the *liquor ammoniæ fort*. Lond. Pharm.), to precipitate the peroxide of iron until the ammonia is in excess. I then collect the precipitate in a filter, and wash it well by repeated affusions of water. I next dissolve about eight ounces of crystallized citric acid (or more, as the case may be) in about four times its weight of water, in a stone-ware capsule, or other suitable vessel, set in a sand bath as before, and raised to a temperature of from 160° to 180° Fah., and add to the solution the per-oxide of iron, prepared in manner aforesaid; and in this moist state continue to add it with agitation until it ceases to be dissolved, that is, until the citric acid is as fully saturated with the per-oxide of iron as their affinities will readily admit of; and, after that, filter the solution. I then ascertain the exact strength of the solution of citrate of iron, by evaporating a certain quantity to dryness, and weighing the dry ferruginous salt. Having thus ascertained the strength of the solution of citrate of iron, I mix it, for the purpose of rendering my improved chalybeate water as palatable and grateful as possible, with a weak simple syrup of sugar, or with a syrup flavoured or aromatized according to the taste, and in proportions, the one to the other, corresponding with the degree of ferruginous strength desired to be given to the mixture. I generally add them in such proportions, that each fluid ounce of the mixture may contain 13 grains of citrate of iron. And, finally, I pour an ounce of this mixture (when of the above strength) into a seven ounce bottle, and fill up with about five ounces of water, charged with three or four times its volume of carbonic acid gas (by means of a soda water machine, such as in common use); and when the bottle has been so filled, it must be corked immediately very tightly, and the cork secured in any suitable manner."

The patentee states that he also prepares a modified triple combination of the citric acid with the oxide of iron, by adding to the citrate of iron above described, some alkali, as ammonia, potash, or soda. He mentions also, that, instead of the citrate of iron, other suitable organic salts of iron (as tar-

**trate or lactate), combined or not combined with alkali (as potash, soda, or ammonia), may be employed.**

## LIST OF ENGLISH PATENTS GRANTED BETWEEN THE 3RD AND THE 28TH OF DECEMBER, 1842.

Thomas Mansell, of Birmingham, agent, for certain improved machinery for cutting or shaping leather, paper, linen, lastings, silks, and other fabrics. December 3; six months to specify.

Ebenezer Timmis, of Birmingham, manufacturer, for certain improvements in apparatus used for arresting the progress of, and extinguishing fire. December 3; six months.

Edward Cobbold, of Melford, clerk, for certain improvements in instruments for writing or marking, part or parts of which improvements are applicable to brushes for water-colour drawing. December 3; six months.

John Stubbins, of Nottingham, hosier, for improved combinations of machinery to be employed for manufacturing certain parts of articles in stocking or lace fabrics. December 3; six months.

Don Pedro Pouchant, of Glasgow, civil engineer, for a certain improvement or improvements in the construction of machinery for manufacturing sugar. December 3; six months.

John Sealy, of Bridgwater, merchant, for an improved tile. December 3; two months.

Charles Heard Wild, of Birmingham, engineer, for an improved switch for railway purposes. December 3; six months.

Thomas Howard, of Hyde, Chester, manufacturer, for certain improvements in machinery for preparing and spinning cotton, wool, flax, silk, and similar fibrous materials. December 3; six months.

William Hancock, junior, of Amwell-street, gentleman, for certain improvements in bands, straps, and cords, for driving machinery and other mechanical purposes. December 3; six months.

Frederick William Etheredge, of Frindsbury, Kent, gentleman, for certain improvements in the manufacture of bricks, tiles, and other similar plastic substances. December 3; six months.

William Henry Stuckey, of Guildford-street, Middlesex, esquire, for certain improvements in filtering water and other fluids. December 3; six months.

William Pope, of the Edgware-road, ironmonger, for an improved stove. December 6; six months.

William Oxley English, of Kingston-upon-Hull, distiller, for improvements in purifying spirits of turpentine, spirits of tar, and naphtha. (Being a communication from abroad.) December 8; six months.

William Coley Jones, of Vauxhall-terrace, practical chemist, and George Fergusson Wilson, of the same place, gentleman, for improvements in operating upon certain organic bodies or substances, in order to obtain products or materials therefrom for the manufacture of candles, and other purposes. December 8; six months.

William Smith Harris and Septimus Hamel, of Leicester, cotton-winders and copartners, for improvements in the manufacture of reels for reeling cotton and linen thread. December 8; six months.

William Kempson, of Leicester, manufacturer, for improvements in the manufacture of muffs, cuffs, ruffs, tippets, mantillas, pelerines, dressing-gowns, boots, shoes, slippers, coats, cloaks, shawls, stocks, cravats, capes, boas, caps, bonnets, and trimmings for parts of dress. December 8; six months.

George Purt, of Saint Mary-at-Hill, soda-water manufacturer, and William Hall, of Woolwich, engineer, for improvents in producing aërated liquors. December 8; six months.

Richard Barber, of Leicester, reel-manufacturer, for improvements in the manufacture of boots, shoes, and clogs. December 8; six months.

John George Bodmer, of Manchester, engineer, for certain improvements in the manufacture of metallic hoops and tyres for wheels, and in the method of fixing the same for use, and also improvements in the machinery or apparatus to be employed therein. December 8; six months.

William Edward Newton, of Chancery-lane, civil engineer, for certain improvements in the construction and arrangement of axles, and axletrees for carriages, carts, and other vehicles used on rail, or other roads (Being a communication.) December 8; six months.

William Lomas, of Manchester, worsted spinner, and Isaac Shimwell, of the same place, worsted spinner, for certain improvements in the manufacture of fringes, cords, and other similar small wares, and also in the machinery or apparatus for producing the same. December 8; six months.

John Grantham, of Liverpool, engineer, for certain improvements in the construction and arrangements of the engines, and their appendages for propelling vessels on water. December 8; six months.

James Brown, of the firm of Messrs. Boulton, Watt, and Company, of Soho, Birmingham, engineers, for certain improvements in steam-engines, and steam propelling machinery. December 8; six months.

Benjamin Fothergill, of Manchester, machine maker, for certain improvements in machines called "mules," and other machines for spinning cotton, wool, and other fibrous substances. December 8; six months.

Charles Keene, of New Bond-street, hosier, for improvements in the manufacture of hose, socks, drawers, gloves, mitts, caps, comforters, and cuffs. December 15; six months.

William Palmer, of Sutton-street, Clerkenwell, manufacturer, for improvements in the manufacture of candles. December 15; six months.

Thomas Cardwell, of Bombay, in the East Indies, merchant, for improvements in the construction of presses for compressing cotton, and other articles. December 15; six months.

Moses Poole, of Lincoln's Inn, gentleman, for improvements in dressing mill-stones. (Being a communication.) December 15; six months.

Charles Maurice Elizee Sautter, of Austin-friars, London, gentleman, for improvements in the manufacture of sulphuric acid. (Being a communication.) December 15; six months.

Guillaume Simon Richault, of the Sablonicre Hotel, Leicester-square, editor of music, for improvements in apparatus for exercising the fingers of the human hand, in order to facilitate their use in the playing of the piano-forte and other instruments. (Being a communication.) December 15; six months.

James Winchester, of Noel-street, hatter, for certain improvements in steam boilers, and in the methods of applying steam or other power to locomotive purposes. December 15; six months.

Edward Robert Rigby, and Charles John Rigby, of Gracechurch-street, London, brush manufacturers, for an improvement or improvements in the manufacture of certain articles in which bristles have been, or are now used. December 20; six months.

Gabriel Hippolyte Moreau, of Leicester Square, gentleman, for certain improvements in steam generators. December 21; six months.

Gabriel Hippolyte Moreau, of Leicester-square, gentleman, for certain improvements in propelling vessels. December 21; six months.

John Squire, of Ponghill, Cornwall, engineer, for certain improvements in steam boilers or generators. December 21; six months.

Taverner John Miller, of Millbank-street, Westminster, oil merchant, for improvements in appa-

ratus for supporting a person in bed, or when reclining. December 22; six months.

William Bridges, of Birmingham, button tool maker, for certain improvements in buttons. December 22; six months.

Henry Purser Vaile, of Alpha House, Old Kent road, gentleman, for improvements in combining mechanical instruments for obtaining power. December 22; six months.

Joseph Beaman, of Smethwick, Stafford, iron-master, for an improvement in the manufacture of malleable iron. December 22; six months.

William Godfrey Kneller, of Wimbledon, chemist, for improvements in the manufacture of soda in the evaporation of brine, and in the concentration, and manufacture of sulphuric acid. December 22; six months.

Robert Wilson, of Manchester, engineer, for certain improvements in locomotive, and other steam-engines. December 22; six months.

James Morris, of Cateaton-street, London, merchant, for improvements in locomotive, and other steam-engines. December 22; six months.

Alonzo Grandison Hull, of Clifford-street, doctor of medicine, for improvements in electrical apparatus for medical purposes, and in the application thereof to the same purposes. December 28; six months.

Thomas Thompson, of Coventry, weaver, for certain improvements in weaving figured fabrics. December 28; six months.

Henry Crosley, of the city of London, civil engineer, and George Stevens, of Limehouse, gentleman, for certain improvements in the manufacture of sugar, and the products of sugar. December 28; six months.

### LIST OF PATENTS GRANTED FOR SCOTLAND FROM THE 28TH OF NOVEMBER TO THE 22ND DECEMBER, 1842.

Thomas Wrigley, of Bridge-hall Mills, Bury, Lancaster, paper manufacturer, for certain improvements in machinery for manufacturing paper. Sealed November 28.

William Coley Jones, of Vauxhall-walk, Lambeth, Surrey, chemist, for improvements in treating or operating upon a certain unctuous substance, in order to obtain products therefrom, for the manufacture of candles and other purposes. December 7.

Charles Maurice Elizee Sautter, of Austin Friars, London, gentleman, for improvements in the manufacture of sulphuric acid. (Being a communication from abroad.) December 7.

Don Pedro Pouchant, of Glasgow, civil engineer for a certain improvement or improvements in the construction of machinery for manufacturing sugar. December 7.

Charles Heard Wild, of Birmingham, Warwick, engineer, for an improved switch for railway purposes.—December 7.

John Browne, of Charlotte-street, Portland-place, Middlesex, esquire, for improvements in the manufacture of mud-boots and overalls. December 7.

William Coley Jones, of Vauxhall-terrace, Middlesex, Surrey, practical chemist; and George Fergusson Wilson, of Vauxhall, in the same county, gentleman, for improvements in operating upon certain organic bodies or substances, in order to obtain products or materials therefrom, for the manufacture of candles and other purposes. December 7.

William Losh, of Newcastle-on-Tyne, esquire, for improvements in the construction of wheels for carriages and locomotive engines intended to be employed on railways. December 9.

Thomas Cardwell, of Bombay, East Indies, merchant, for improvements in the construction of presses for compressing cotton and other articles. December 9.

Charles Augustus Preller, of Eastcheap, London, merchant, for improvements in machinery for preparing, combing, and drawing wool and goat's hair. (Being a communication from abroad.) December 9.

Thomas Seville, of Royton, Lancaster, cotton-spinner, for certain improvements in machinery used in the preparing and spinning of cotton, flax, and other fibrous substances. December 9.

William Young, of Queen-street, London, lamp-maker, for improvements in lamps and candlesticks. December 12.

George Edmund Donisthorpe, of Bradford, York, top-manufacturer, for improvements in combing and drawing wool and certain descriptions of hair. December 12.

John Bishop, of Poland-street, Middlesex, jeweller, for improvements in apparatus used for retarding carriages on railways, parts of which are applicable for portioning power; and improvements in steam-cocks or plugs. December 12.

Isham Baggs, of Wharton-street, chemist, for improvements in the production of light. December 13.

Gabriel Hippolite Moreau, of Leicester-square, Middlesex, gentleman, for certain improvements in steam-generators. December 13.

John George Bodmer, of Manchester, Lancaster, engineer, for certain improvements in the manufacture of metallic hoops and tyres for wheels, and in the method of fixing the same for use; and also improvements in the machinery or apparatus to be employed therein. December 19.

William Lomas, of Manchester, Lancaster, worsted spinner, and Isaac Shimwell, of the same place, worsted-spinner, for certain improvements in the manufacture of fringes, cords, and other similar small wares; and also in the machinery or apparatus for producing the same. December 21.

Moses Poole, of Lincoln's-inn, Middlesex, gentleman, for improvements in dressing mill-stones. (Being a communication from abroad.) December 22.

William Palmer, of Sutton-street, Clerkenwell, Middlesex, manufacturer, for improvements in the manufacture of candles. December 22.

*Street-sweeping Machine.*—We understand that Whitworth's "Patent Cleansing Machine," which has been in operation in Manchester for the last ten months, and has given universal satisfaction, is about to be introduced into the metropolis. Manchester, instead of being the dirtiest, is now, we believe, the cleanest of our large towns. The introduction of the machine here induced a smart competition between it and the old force of sweepers; and, although the latter are unable to maintain that degree of cleanliness in their districts, which is accomplished by the machine in the one allotted to it, the general improvement in the town, over former years, is very striking. The power of the machine is extraordinary, being equal to thirty men; and, in its operation, the numerous annoyances which are inseparable from the old mode are altogether avoided.—*Manchester Guardian.*



## END OF VOLUME THIRTY SEVEN.

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## *NOTICES TO CORRESPONDENTS.*

[Selected from the covers of the Weekly Numbers, as being more or less of permanent interest.]

MR. WEBSTER'S BOOK ON PATENTS *is the latest, and also the best.—" A Patent Proprietor" may also consult with advantage the smaller work by the same able and judicious writer on " The Subject Matter of Letters Patent for Inventions."*

MODELS OR SPECIMENS OF INVENTIONS *may be sent to the Polytechnic Institution, where they will be exhibited to the best possible advantage, and where inventors are sure, besides, to experience the most courteous treatment at the hands of the manager and secretary.*

PARTICIPATION IN INVENTIONS *(A Master Manufacturer).—If the workman was merely employed to work out his master's ideas, and invented nothing himself, he has no claim in law or equity to any share of the proposed patent.*

DISCLAIMERS *are not all advertised. The law officers of the Crown may do as they please in this respect.*

TREVETHICK *is still without any monument to his memory—the more the shame. He lies buried in Dartford churchyard.*

DISCOVERY OF THE LONGITUDE.—*P. V. has won. There is no longer any reward offered by Government in relation to the discovery of the longitude. The truth is, that the skill and ingenuity of our chronometer-makers have left nothing to be discovered.*

THE GOVERNMENT SCHOOL OF DESIGN *teaches drawing only, and as long as it does so, will never turn out a good practical designer of soft goods patterns. "D. S." should send his son to some of the Manchester or Glasgow print-works.*

DESIGNS REGISTRABLE UNDER THE NEW ACT.—*(A Designer.) The New Act strictly confines the privilege of registration to* ornamental *designs.*

FICTITIOUS USE OF THE TERM "PATENT." *There is no statutory penalty; the only objection is, that the thing is dishonest, and would probably be held to be a fraud by the common law of the land.*

PERPETUAL MOTION. *The following brief extract from the illustrious Smeaton, may perhaps suffice for an answer to "Experimentalist." "We want (for perpetual motion) bodies having the following properties: that when they are made to* ascend *against gravitation, their absolute weight shall be* less ; *and when they descend by gravitation through an equal space, their absolute weight shall be* greater, *which, according to all we know of nature, is a repugnant or contradictory idea."*

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